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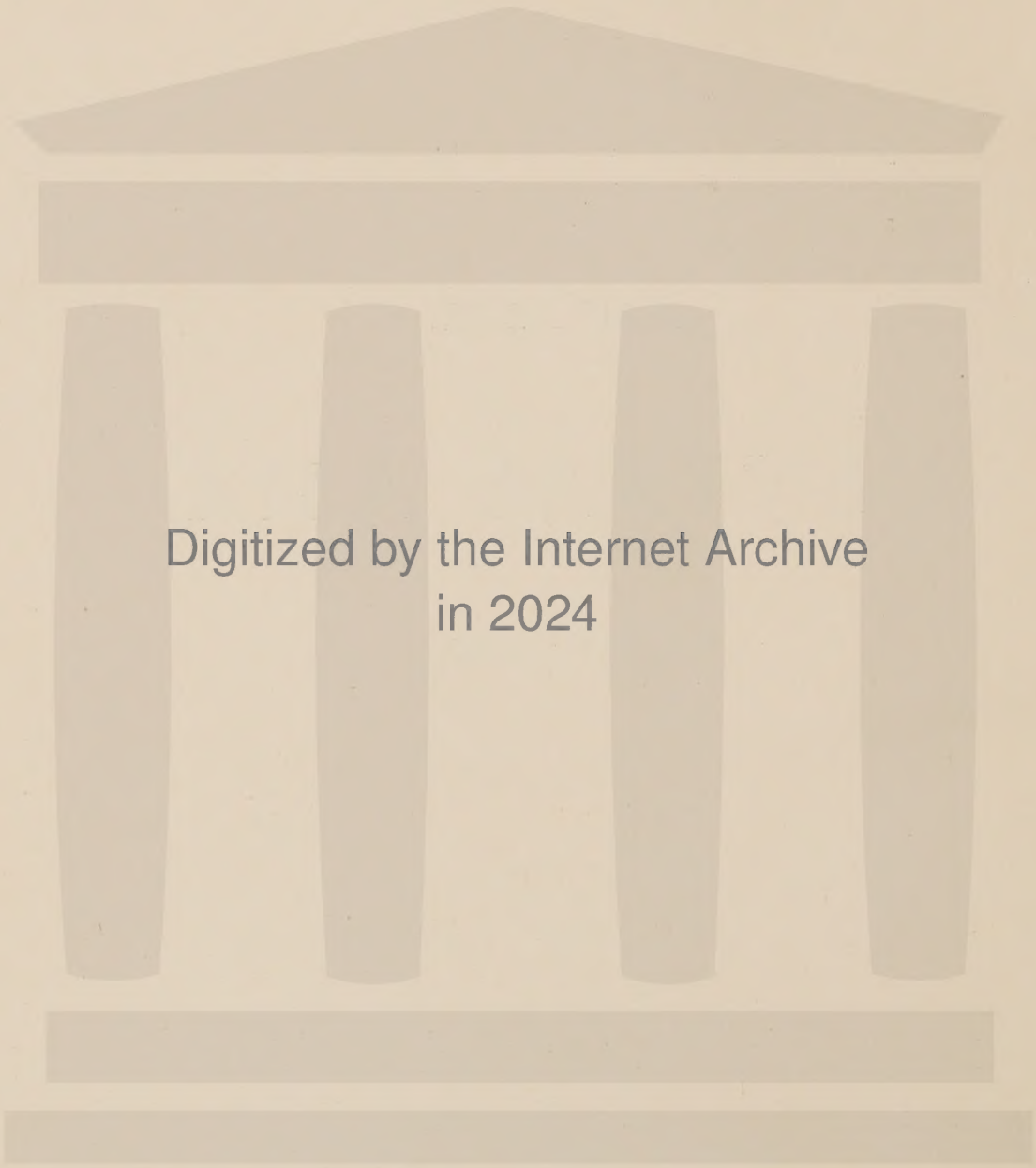
SVEN HEDIN

CENTRAL ASIA

1899–1902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SVEN HEDIN

SCIENTIFIC RESULTS

OF A JOURNEY IN

CENTRAL ASIA

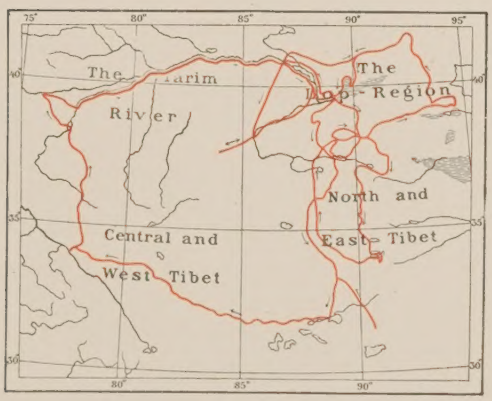
1899–1902

VOL. IV

CENTRAL AND WEST TIBET

BY

DR SVEN HEDIN



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FROM CENTRAL TIBET TO LADAK

CHAPTER I.

TO THE SATSCHU-TSANGPO: A PADDLE DOWN THE SAME.

In the third volume of this work I have given a detailed account of the geography of Eastern Tibet along the routes by which I crossed the country in 1896, 1900, and 1901. The same volume contains also a description of the last great meridional journey from Tscharklik to the farthest point south that I reached. Then I have further described our return to the caravan, which we found on 20th August at the camp numbered LXIV. Consequently I have carried the account of my 1899—1902 journey so far that all that now remains is the journey to Ladak, and thence by the well-known route over the Kara-korum. My immediate plan, after rejoining the headquarters caravan, was to march with the entire body as far south as I could possibly get, that is until the Tibetans put such obstacles in our way as should compel us to turn back. I hoped however that this would not happen before we reached the lakes of Selling-tso and Naktsong-tso, which Bower and Littledale discovered; though it is true that these distinguished travellers only touched the two lakes without mapping them to any extent, a thing that could however scarcely be expected considering the tremendous difficulties which they had to contend against, even as I had. When I was stopped, upon reaching the farthest point south to which I should be able to penetrate, I intended to make direct for Ladak, even though by so doing I ran the risk of coming into too intimate connection with Littledale's route; but upon looking at his map, which I carried with me, I found that it did not fulfil even the most modest requirements of a field-map, and consequently I considered myself justified in looking upon the parts of Tibet through which he and Nain Singh journeyed as almost entirely a *terra incognita*. After spending the winter in Ladak and India, I intended in the following spring to travel north over the Kara-korum and so return to my point of departure, Kaschgar.

As I did in the third volume, I will first describe step by step the country I travelled through, and then give a general account of northern and central Tibet, in so far as that country is known through my own journeys and those of other travellers; and in conjunction with this I will take a glance at the journeys of the latter, and examine more closely the results at which each of them has arrived.

After reaching Camp LXIV my first thought was to get back as quickly as possible to the spot from which I set out for Lhasa, that is to say to Camp XLIV, in order that I might adjust my chronometers. On the 21st August therefore we started again to travel across the softly rounded hills of loose red earth, with a thin sprinkling of grass on them, which rise on the right bank of our old friend, the main stream. Here the men of my caravan had during my absence built up several cairns of stones, to serve as landmarks to guide me in case I should return at a time when they were a long way from Camp XLIV. I mention this lest any future traveller should be astonished at finding these heaps of stones and be puzzled to account for them. In a little side-glen, which joins the main glen from the left, there is a large obo of flat slabs inscribed all over with the formula »On mane padme hum». The Tibetan hunters, who principally visit the locality, seem to go on adding to the heap by occasionally placing a fresh stone against it. At any rate it was easy to see that some of the slabs were worn by wind and weather, while others were quite fresh, and their lettering sharply and distinctly cut. Generally speaking, the oldest signs, those which are half obliterated, were originally cut with greater care than the more recent ones.

Fig. 1. A HALT EN ROUTE.

In consequence of the recent copious downfall the main stream was greater than it had been in the end of July. We encamped on precisely the same spot as before. My astronomical observations were however greatly impeded by the abundant rain that fell during the three days that we spent there. Sometimes it fell in the form of light rain, sometimes, and more especially at night and in the morning, in the form of snow. As a consequence of the caravan's stay of about a month in this locality almost all the wild animals had disappeared.

When we at length started again for the second time, on 25th August, from Camp XLIV, in order to traverse that part of the highlands which still lay between us and the Selling-tso the sky was anything but propitious; but it seemed hopeless waiting for better weather, the glens and mountains were constantly filled with dense, dark masses of cloud, and the sun showed himself but seldom. The incessant downpour of the last few days had also made the loose earthy hills in our neighbourhood as soft as pap. The entire region was like a veritable dumping-ground for all the mud for miles round; we sank into it deeply without finding bottom. When we started it was raining cats and dogs; nevertheless we proceeded, travelling south, with an inclination towards the west, and having forded the river

Fig. 2. ON THE TIBETAN PLATEAU.

which was then in fuller flood and muddier than ever, we ascended the bed of a little contributory watercourse on the opposite side. There the ground was one vast pudding, and we were obliged to zigzag a good deal and often to retrace our steps for long distances. The watercourse led up to a little pass having an altitude of 5198 m. After that we crossed over a second, smaller threshold, as well as a stream swollen from the rain and flowing towards the N. 70° E., which united shortly afterwards with the river of our headquarters camp. Thence the ground sloped slowly up towards a main pass in the foothill range at an altitude of 5236 m. This climb was one of the stiffest, if not absolutely the very stiffest, that I have ever made in Tibet. Had I not been accompanied by so many men we should have been obliged to leave several of our camels behind; but as it was, by all working together, we succeeded in saving them all. One lesson I learned thoroughly, that neither summer nor autumn, nor above all the rainy season, is the time to choose for travelling in Central Tibet. It is only in late autumn, in winter, and in spring that the ground bears everywhere.

On the southern side of the greatly flattened pass a most welcome change took place in the character of the surface; for it was there firmer, and bore for the most part, whether this was in consequence of its own composition or of its southern exposure, causing it to dry better between the showers. From this pass we descended by a glen that runs first to the south-west, then to the south, and finally to the south-south-east. Generally this glen is broad, and bordered by hills not very steep and bearing a little miserable grass; it is only at the bends that it contracts to a narrow, deeply trenched gorge. The stream then flowing down it may have carried 1 cub.m. of water in the second. Lower down the glen widens out, and we travelled along the slopes on its right-hand side, where there was a more abundant supply of grass. The country to the south undulated a good deal, though it was flat and open for a fairly considerable distance ahead. We pitched Camp LXV beside a brook that came down from the right, at an altitude of 5107 m.

As usual, hard rock was rare. On the principal pass was sandstone, dipping 31° towards the S. 5° W., and in the narrow gorge-like part of the glen a black, close-grained rock, dipping 64° towards the S. Apart from these, the country consisted entirely of red hills, the disintegrated product of red sandstone, and presumably also of clay-slate. This is the conformation which, when it becomes wet, is so exceedingly difficult to march on; the only places in which it bears are those in which grass grows.

On 26th August we accomplished a very monotonous stage across the flat country. We travelled south-south-west, leaving the river on our left and having low hills quite close to us on our right, while at a distance of about 40 km. to the west was a minor snowy mass with rudimentary glaciers, which was continued towards the south by a biggish range, above which rose a couple of peaks crowned with perpetual snow. So far as we were able to see from the distance this range thus forms an exception to the general rule, by having a meridional axis; but it is so short that at its southern end it leaves room for the flat latitudinal valley in which we were then travelling. In the same valley, and not very far to the east of the meridional chain, there is a moderate-sized lake, which one of my Cossacks had already examined. He reported that its southern shore was so mountainous that it was scarcely possible to skirt the lake on that side. It was entered, he said, by the stream that flowed close past Camp LXVI on the north, going towards the S. 75° W., and uniting, immediately below the point where we forded it, with another river coming from the north. The latitudinal valley of which I am now speaking is unlike those of northern Tibet; for, while it does indeed make a depression running east and west between two great swellings of the earth, the relief is in general less regular and less distinct, owing to the valley being interrupted by detached buttes and offshoots of the main ranges. In the quarter where we crossed over it, it was more like an extensive plain or flat cauldron-shaped arena, shut in on every side, though at a considerable distance, by mountains. Its lowest part, on the left bank of the river, reaches an altitude of 4863 m. Here there was some grazing on the sandy tracts. This region abounded also in pools, big and little, probably owing their origin to the recent rains. Dense masses of cloud clung to the summits of all the mountains, although this day we were spared any rain.

Nor did it rain during the night, a fortunate thing for us, for next day we travelled through a country that was extremely sensitive to wet. Even as it was we found it difficult work to get on, our progress not exceeding 3 km. in the hour. In some places the surface had dried somewhat during the last twenty-four hours, yet not sufficiently to have acquired its normal degree of firmness. A layer of dry fine dust, a decimeter thick, rested upon wet blue clay intermingled with sand, and into this the animals dropped foot-deep. All the watercourses that we crossed over were directed towards the west. On the whole the surface rose as slowly as possible towards the south, that is towards the mountains which border the latitudinal valley on that side. The country was however fairly rolling, for we crossed over one flat ridge after another. Several of the drainage channels between these ridges were especially difficult to get across (fig. 3). Although only half a meter wide they were a meter deep, and we had to make wide detours to get round them, or, as happened in one or two cases, had to fill them up with earth, before we were able to effect a passage across them. Other depressions between the hills presented the shape shown in the accompanying sketch (fig. 4). In them too the surface consisted of fine yellow sand and dust, resting upon a substratum of blue clay. Most of the watercourses contained water and emptied themselves either into pools or into a small lake which we passed at some distance to the west of our route. Directly opposite to this lake we detected, unexpectedly enough, the footprints of camels, though in one locality only. These had nothing to do with our caravan, for during my absence my men had never penetrated so far south. Possibly they were due to some Mongol caravan, which contrary to the usual custom had left its camels in the mountains, and had continued its journey to Lhasa with horses or hired yaks. At intervals we also came across traces of older camp-fires. We saw here the skeleton of a recently shot and slaughtered yak. Wild animals were now becoming scarcer, an orongo antelope or kulan showing itself occasionally, though there were hares and ravens. The vegetation was thin. Except for wild garlic, which was quite abundant in places, there was scarcely anything else but *japkak* and *jer-baghri*.

Fig. 3.

On the whole the country was painfully monotonous: we travelled all day without finding any noteworthy change. Immediately to the east of our route was a stretch of low hills and it was off their summits that all the brooks flow which make their way into the lake. The eastern shore of this is flat, and the lake shallow, while the shore-line is very irregular, being diversified by bays, promontories, and low-lying islands. The whole belt of shore consisted of barren mud, so soft that it refused to bear the weight of a man. Consequently we were unable to get any nearer to the lake than we actually did. Most of the brooks that enter this basin pursue each an independent course, some with, others without a delta; only a

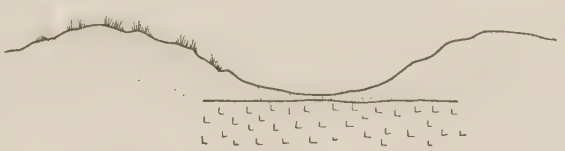


Fig. 4.

few conjoin two and two before entering the lake. On the west shore rise flat, rounded hills. The outline of the lake is so far unusual, that it is elongated from north to south; that is to say it lies athwart the latitudinal valley, and thus parallel to the recently mentioned meridional range. This lake appeared to be situated in the same latitudinal valley as Camp XLVII, though that valley is neither distinct nor continuous, but is interrupted at intervals by smaller buttes and hills. We did not see hard rock anywhere during this day's march. Camp LXVII was situated at an altitude of 4910 m.

August 28th. The rainy season appeared to have passed its climax, and the fine days were beginning to return. It seemed to be characteristic of this season, that the mornings were perfectly bright, indeed burning hot, but from noon onwards the sky was veiled with thick clouds. So it was to-day: after a still and glorious morning, the sky about 11 o'clock became all at once clouded, nor did the clouds lift during the rest of the day. The only inconvenience that they caused us consisted in the cold, raw shade they threw, and the occasional gusts of wind now from one direction, now from another; but it was very seldom that we had a hasty shower of hail or snow. This day the country was unfavourable for marching, not because it was marshy, for now only the depressions were boggy, as well as the level ground and the slopes facing north, but it was difficult because of its broken character. We found in our path several small ranges and stretches of hills, the passes in which were, it is true, quite easy; but none the less it was a difficult country for our emaciated animals. The relative differences of altitude were quite insignificant and all the slopes were flat. Generally we kept at a score or so of meters above the 5000 meters contour-line. These ridges too consisted of soft disintegrated material, with the thinnest sprinkling of grass on them. We only saw hard rock in the distance, and on the higher summits; along our actual route the only place in which we discovered it was on the highest pass: that was a hard crystalline schist dipping 45° S.

Camp LXVII was situated on the left bank of a larger eroded watercourse, coming from the range that borders our glen on the south. The stream in it carried in the morning a volume of 1 to 2 cub.meters. We followed it up towards the south-east, marching the whole of the time in the bed of the stream, for that was the only place in which the ground would bear the weight of the caravan, the surrounding slopes being soft and treacherous. In one or two places we found indications of yak-hunters' encampments. The next pass was easy, being rounded in form, and had an altitude of 5048 m. The prospect towards the south was not very encouraging. Immediately below us was a shallow cauldron valley, bounded on the south by a fresh short range. This we thought we might get round on the south-west; but as the ground in that direction refused to support us, we turned off to the south-east. In the eastern part of the new valley some small rivulets united to form a brook, which proceeds towards the west, either to enter some self-contained lake or else to pierce the low hills which in that direction terminated the view. This brook, which was carrying a volume of half a cubic meter, guided us up to a minor threshold in a secondary spur of the southern range, and after that we had a gentle ascent to the pass proper, the altitude of which was 5089 m. As we stood on the

Ljustr. A. B. Lagrelius & Westphal.

READY FOR MARCHING.

summit of the pass we saw to east and west projecting spurs of the same range, and at a greater distance to the east a bigger free-standing mass; while before us to the south was a bare red chain, which however we apparently could get round on the east. A little rivulet ran down from the pass first towards the south-south-

Fig. 5. VIEWS TAKEN ON THE FLAT OPEN PLATEAU OF CENTRAL TIBET.

east, then towards the south, and finally towards the south-east. Contrary to the usual custom its bed was softer than the adjacent country; for while it consisted of coarse loose sand into which our animals sank, the dry exposed mud at the side was hard. We encamped on its right bank beside some small freshwater pools at

an altitude of 5068 m. The grazing here was worse than it was in many places farther north. Generally speaking the route that we had pursued towards the Tengri-nor was far more convenient as regards contours than this present more westerly route that we were now pursuing.

Fig. 6. VIEWS TAKEN ON THE FLAT OPEN PLATEAU OF CENTRAL TIBET.

August 29th. The nights were now beginning to be colder, and this morning the ground was white with heavy hoar-frost, but within half-an-hour after the sun rose it had nearly all disappeared, except on the higher slopes of the mountains facing north, where it remained until noon. The going was good, owing to the

surface having dried during the last few days. We crossed over five small passes. Here again the characteristic east-west extension of the mountain-ranges was especially emphasised. Hard rock showed at several places; it consisted of a hard, close-grained variety, which like all the varieties which I have hitherto mentioned and all those which I have yet to mention, is carefully described in the geological part of this work.

The principal brook then continued towards the S. 75° E., being bordered on the north by the last range that we had crossed over the day before. This range now turned out to be double, and its lower crest was pierced by several side-glens. On the south the brook is bordered by very low hills, on the other side of which we found a flat depression with a couple of larger pools in the middle of it. Each of these was surrounded by boggy ground, which fortunately we were able to avoid. From these pools we made our way up to a minor range (5083 m.). Immediately south of it came yet a second range of precisely the same character. Down the glen that lay between the two flowed a brook due east; and beyond the second range was a second glen running down in the same direction as the first one. We had the highest part of the last named glen, together with its flat pass, on our right. Towards the east the glen terminates in a sort of rocky gateway, which affords an uninterrupted view of a distant mountainous country, one conspicuous mass in which was white with hoar-frost. Then we crossed over a fourth low threshold, and after that a fifth. This last was however of more consequence than the others owing to its forming an important and more definitive water-parting; for it sends off towards the east a watercourse which unites with all those that I have just mentioned, and these all clearly belong to the same hydrographical system as the principal stream at Camp LXVIII. West-south-west from the pass runs a glen which we followed for two days. The upper part of this glen is broad; but on both sides of it a couple of bare rocky spurs pierced through the everlasting disintegration detritus. Down the middle of it flowed a small brook, and in several places there were natural springs. The grass was occasionally fairly rich; the country was dotted over with evidences of recent encampments and there was a good deal of yak-dung, evidently left by tame yaks. The glen soon inclined towards the south and broadened out. Then we once more saw our path barred by an east-west range; but as it was pierced by the glen we were marching in, there was clearly no need to climb over it. As the grazing just outside the breach through the range was good, we pitched there Camp LXIX, at an altitude of 4889 m. In this neighbourhood we observed numerous signs of the presence of nomads; for one thing, sheep-droppings were quite common. There were large troops of kulans and several species of antelopes, and also mountain sheep, wolves, hares, and ravens. Not very far from our camp we observed a great number of heaps of stones and mounds of turf, apparently forming some sort of a boundary line.

The 31st August was again a beautifully warm day, with neither wind, nor rain, nor hail. We now followed the stream downwards through its rather deep, distinctly modelled transverse glen. After this we definitively descended, except for a small secondary pass. The going was favourable and the ground bore everywhere. The grass however was wretched. No nomads could encamp for any length of time in such a locality; possibly therefore the traces of encampments that we

saw were only the places where they had halted for a day or two whilst travelling to better grazing-grounds east or west of our route. After emerging from the transverse glen, where I found again the same hard, close-grained variety of rock that I have last mentioned, the stream describes a wide curve to the east. Between it and our route were two small spurs stretching east and west. The altitude of a secondary pass in the more southerly of these reaches 4909 m. On its southern side the surface again falls away perceptibly towards the river. On the left side of the latter are low hills, amongst which wind several tributary brooks. At length we crossed over the main stream, at that point divided into several arms; its water was clear, the volume being only 1 cub.m. The stream then proceeds south-south-west and empties into a little lake, with flat shores, except on the south-east, where the mountains slope down towards it. Its extremely isolated situation in such a level valley suggested at once that its water must be salt. On its shores were a number of eagles, with some unfledged young ones. Continuing on past a smaller detached butte, we came to a spring-fed brook running towards the lake, though it was too feeble to be able to reach it. The altitude here was 4733 m. The lake may have had an altitude of 4700 m., which is rather lower than Tso-nek (4715 m.), the lowest point on the route that we followed towards Tengri-nor. We were now clearly approaching relatively lower parts of Tibet, although the relative differences of altitude did not amount to more than a couple of hundred meters.

Our stage of the 1st September produced in several respects a change in the monotonous circumstances under which we had lived for several days past. The weather still continued to be good. Although the wind blew hard from the north, the sky was covered with clouds; nevertheless it was only once or twice that we had a slight shower of rain or sleet. The surface was everywhere hard and bore readily, but was very broken. From our last camp we ascended very slowly, crossing at first over a countless number of small rainwater rivulets, all of which meandered down from the relatively low heights that rose immediately east of our route. They were from 1 foot up to 2 or 3 m. in depth, and often had precipitous terraced sides. These tiny rivulets gradually united into bigger ones, and these last made their way into a little lake which lay some kilometers to the west, its shores white with crystallized salt. At length we reached the watercourse leading up to a convenient pass in the minor range which sends out its spurs northwards to the southern shore of the lake. The country was almost entirely barren. The highest summits east and west of the little pass were crowned with cairns of stones, plainly intended to mark where the range can be crossed. Here again we once more began to find indications of the presence of human beings, in that we came across several sites of encampments, though none of them recent. The altitude of the pass was 4809 m., that is, it was as high as the top of Mont Blanc, although it only reached 100 m. above the level of the lake. The range therefore is quite an insignificant obstacle. The pass however forms a decided water-parting, for the glens on its southern side run down to a little lake in the east-south-east, the lowest depression in a fresh self-contained basin; but the range does not stand out with the same distinctness as the ranges which I have previously mentioned. It appeared rather to be a flat offshoot from a minor group of mountains, which probably in their

turn are connected with higher mountains farther west. The mountain-group which we now had on our right possessed a jagged crest, with hard rock sticking out here and there. This crest sends off towards the east a number of flat spurs, with rounded outlines; and the eroded watercourses between them, though then generally dry, converge upon the lake. These ridges we crossed over at right angles, our direction being almost due south. The lake lies only a few kilometers distant from the spurs in question, and on its eastern side are other spurs, which, so far as we were able to see, stretch north and south, though properly speaking they ought to

Fig. 7. TIBETAN VISITORS AT DSCHANSUNG.

be regarded as subsidiary connections of a mountain-system extending east and west, but now broken and indistinct. Another pass, which was in every way secondary, reached an altitude of 4859 m. South of it the watercourses converge upon a fresh flat depression of small size and without a lake. But notwithstanding the slight relative altitude of this pass, it afforded a particularly extensive view. Towards the south-south-west the highlands were perfectly level for a distance of several days, there being neither swelling nor ridge to put any obstacle in the way of our caravan. But in the far off distance we fancied we could detect a dark line, which might indicate mountains. The wide extent of the view could only be occasioned by the presence of an unusually large lake, and although we could not see any lake, I knew that we could not be very far from the Selling-tso. At no great distance to the S. 64° E. was a quite small lake. Hence there was in this region

a meridional chain of small depressions, by which there pretty certainly runs a far easier route than that which we were following. To the S. 20° E. we caught the glimmer of white, no doubt a desiccated salt lake. To the south-east and east were mountains of moderate elevation. On the other hand we nowhere perceived any conspicuous dominating peaks. The orographical dimensions were far more modest than they had hitherto been, the relative differences of altitude being slight and the entire country leveller. During this stage we only observed hard rock in two places. The first was red sandstone, together with a fine-grained, crystalline variety, dipping 54° towards the N. 15° W. and exposed at only one spot in a deep watercourse. The second was a hard, fine-grained rock, varying in colour from light yellow to white; this made a sort of shoulder or bluff near our camp at the end of the march. Apart from these the surface consisted everywhere of fine brick-red dust. Even gravel was very seldom met with; it occurs only in the bottoms of the eroded watercourses.

At this camp, which was 4794 m. above sea-level, we fell in with a nomad encampment of 13 persons, possessing yaks, horses, and sheep. These people called the region Dschansung, and said that they were directly subject to the authority of the Pantschen Rimpotsche of Taschi-lumpo.

On the 3rd September we proceeded towards the south-south-west and south-west, the country being extremely level and easy; what undulations there were were at all events quite trifling, and for long distances the surface appeared to be as level as a floor. Nevertheless it is divided into a number of small flat, self-contained drainage-basins, and consequently disconnected pools are quite numerous. On the whole however this wide plain slopes gradually down towards the Satschu-tsangpo, more particularly from a little threshold at an altitude of 4750 m. Immediately east of this swelling is a small lake, situated in a long, broad, and flat depression, in which there was a fair amount of grass. In several directions we saw the tents and flocks of the nomads. Farther on the grazing was in several places exceptionally good. Broadly speaking, we were travelling in a broad valley bordered both east and west by very low, rounded mountains, from which side-glens debouch at intervals upon the main valley. The main valley does not however possess any definite eroded watercourse, but all the brooks and rivulets that we crossed over terminate in self-contained pools and miniature lakes. In its general character this valley resembles the usual latitudinal valleys, except that its almost meridional direction is unusual.

At the point where we approached the Satschu-tsangpo, that is in the vicinity of a small isolated hill, evidently not very far from the point where Littledale forded the river, it was divided into two branches by a low mud-island. One of my men who swam across, reported that the river was not more than 1 1/2 m. deep. I decided I would not take the caravan across, for that would have brought us too closely into contact with Littledale's route on the eastern shore of the Selling-tso. I resolved to go round by the west side; which would also save us the trouble of ferrying the caravan across. We encamped therefore on the right bank of the stream at a spot which lay 4613 m. above sea-level. The river here is very winding. In the narrower passages the velocity was considerable, but in the broader parts the

current was slow. The water was decidedly muddy; evidently it had recently been raining somewhere in the adjacent mountains.

From this point, Camp LXXII, I travelled in my canvas skiff down the river to the Selling-tso, arranging to meet the caravan on its northern bank. Fortunately I measured the dimensions and volume of the river before starting; for lower down this would have been almost impossible because of the breadth and slowness of the current. At the camp just mentioned the breadth was 68 m.; the maximum depth, 1.50 m.; the mean depth, 0.84 m.; the mean velocity, 0.99 m.; and the volume, 56.5 cub.m. in the second. Thus it was quite a considerable stream for the highlands of Tibet, and although I had no positive proof of it, I concluded, with a fair amount of certainty, that this river could not be other than the lowest course of the Satschu-tsangpo. Both the position and the volume lend support to the supposition, and it was subsequently confirmed by the natives, who told us that it bore here the same name as it does in the locality where we forded it before. This is the name too that was given to Littledale, though he writes it Sachu. The rainy season was now almost past; consequently it was only natural that the volume should be less than it was in the beginning and middle of August. All the same, there were evidently mountainous regions within the river-basin in which no inconsiderable amount of rain was still falling; otherwise the volume would have been even yet smaller than it was. That the river had quite recently carried an enormous volume was perfectly clear from the marks on its banks 1 m. and more above the then existing level.

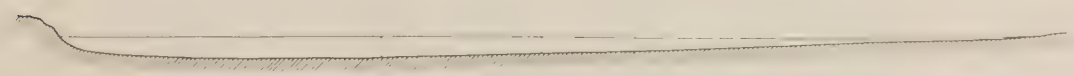


Fig. 8.	1.50	1.45	1.10	0.70	0.31	depth.
	171	152	129	117	79	velocity.
	185	165	141	110	72	

The Satschu-tsangpo at Camp LXXII. Breadth = 68 m. Scale 1 : 500.

Leaving Camp LXXII we were carried at a swift rate down the river, first towards the north-east, then north-west, and shortly afterwards west and south-west, all in agreement with Littledale's map. This very winding part of the river marks a breach through sandstone and conglomerate formations which dip at an angle of 19° towards the S. 10° W. The latter forms on the right bank of the river an almost precipitous bluff a score of meters in height. The sandstone is for the most part red, though green and grey also occur. It forms small ridges and thresholds, distinctly visible in the bed of the stream. After it emerges from this rocky passage, the river flows across flat alluvial ground in a particularly straight course, without exhibiting any further windings worth speaking about. As soon as ever the last of the thresholds are passed, the banks grow lower, though on the concave, eroded side they reach a vertical height of 4 to 5 m. On the opposite, sedimented side there are long, narrow sand-banks, which at that season were not yet connected with firm ground, but were separated from it by narrow strips of almost stagnant water. The river was here broader too, and the velocity decreased, though the depth still continued appreciable. The only place in which we could have forded

the river with horses and camels would have been in the vicinity of Camp LXXII. Very often the stream was divided into two or more branches by flat islands of silt or sand. From the point where the river assumes a south-westerly course, it alters its appearance in that it increases still more in breadth: while the eroded banks still preserve a height of 4 to 5 m., the distance between them increases. Here they are equally high on both sides of the stream, the river flowing as it were at the bottom of a deep trench with vertically cut sides. The depth is inconsiderable, and the skiff frequently grounded even where the current ran strongest. Here then the depth would offer no impediment to the passage of a caravan; but the bottom did not bear everywhere and the scarped banks presented an insuperable obstacle. About one-half of the river-bed was occupied by alluvia, across which the water gently wound its way. During high flood these patches are beyond doubt completely covered with water, so that the lowest part of the course of the Satschu-tsangpo must then form a single wide current, flowing between perpendicular escarpments and moving everywhere with considerable swiftness.

Fig. 9. TIBETAN TRYING TO CATCH A LIVELY HORSE.

About 5 km. north-west of the river rises a small ridge in the glen-opening, and on its slopes we saw herds of yaks and sheep, besides one or two tents. Except for this the country adjacent to the river consisted to all appearance of a perfectly level alluvial region, of hard, dry, horizontally bedded yellow clay, clearly a former lacustrine deposit, through which the Satschu-tsangpo now ploughs its way. From the point where we embarked down to its mouth the river is joined by no tributaries, though there are indeed dry gullies formed by transient rains and making, as it were, narrow gateways or sharp incisions in the high scarped banks. Every now and again we passed a tiny eminence beside the river; but these were the only

irregularities of the surface worth mentioning. The grass was in places good, but grew less promising the nearer we approached to the river-mouth. The neighbourhood was remarkably destitute of animal life; the only wild animals we saw at all were some kulans at our camp at nightfall. These creatures were less shy than those of northern Tibet, the reason being that they are never molested. We nowhere saw any nomads on the banks; their tents stood at the foot of the mountains where the grazing was probably better. At Camp LXXIII the river again contracted, and deep places occurred; there the current was hardly perceptible, except as it swirled around the masses of earth which had fallen in from the banks. At 3 o'clock a violent wind sprang up from the south-west, sweeping before it clouds of fine drifting dust off the steppes beside the river, so that the entire country became enveloped in an impenetrable haze. Evidently then the ground had here dried all over after the last rain. As the stream was flowing south-west, that is in the teeth of the wind, its surface was whipped into high foam-tipped waves.

September 5th. Below our camp the river grew increasingly narrower, the breadth being seldom as much as 100 m., while the *jar* terraces were higher, shutting out the view on both sides, and at the same time the alluvial patches were less and less frequently exposed and as narrow as could be, though still separated from the bank by thin strips of water. At five separate places in this constricted passage the river made its way down little cataracts, formed by thresholds across its bed, and jutting out first from the one bank and then from the other, and sometimes slanting right across the river. Upon a closer examination of these thresholds, I found that they did not consist of hard rock as they did in the vicinity of Camp LXXII, but of friable slabs of sandstone, built up into broad, flat ridges that project above the sediment in the river-bed. In places they form little shallows or islets, which reached a few centimeters above the then existing level. It is close to these that the velocity is always greatest, because of the slightness of the depth. Nevertheless the depth was nowhere so great as it was at Camp LXXII. Still in this respect the river changes a good deal, not because of any variation in its fall, but simply as a consequence of the characteristics of its bottom. Where that is hard and consists of the last surviving ruins of sandstone ridges, the river is narrow, shallow, and swift; but where the stream flows entirely over alluvial clays, it is broader, and its current deep and sluggish.

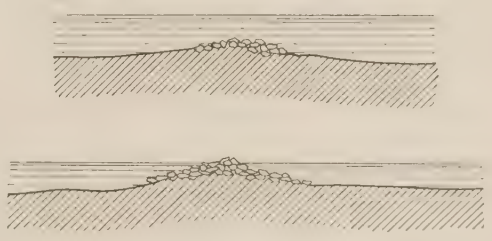


Fig. 10. THRESHOLDS IN THE RIVER-BED.

At length the river alters its course abruptly from the south-west to the east-south-east, making a very sharp and peculiar angle. There it is joined from the right by a species of temporary tributary, or rather by a gully deeply and energetically carved through the fine, yellow clay. This appeared to proceed from the mountain-mass F_2 to the N. 11° W., and pretty certainly carries water during the rainy season only. This gully again is joined just above its mouth by a smaller similar gully coming from the west. The latter was then perfectly dry, but in the

mouth of the former lay a small lagoon, and in it there were actually some fish. A little higher up its bed contained some puddles set about with oozy matter, so soft that it would hardly have allowed a hare to run across it. Above these collections of water the bed of the gully was beset diagonally by one of the usual thresholds of flaky sandstone; that was the only place in which the gully admitted of being crossed over, and this fact was indeed evidenced by a heap of stones built up on the top of the scarped bank. Down this tiny barrier the merest rivulet of bright water was trickling, thus showing that it had its origin in a spring in the bed of the gully itself. In the river directly opposite to this threshold there was a similar threshold, which consisted so far as I was able to make out, for it was entirely under water, of hard sandstone, dipping 27° towards the S. 50° E.

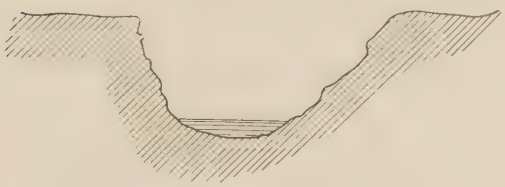


Fig. 11. VERTICAL SECTION OF GULLY.

After that the river is joined by a number of similar gullies, exhibiting the same fantastic and peculiar shapes. It is there narrower than ever, barely 80 m. across, and with its abruptly scarped banks has much of the appearance of an artificial canal. There too the alluvium is absent, except for a couple of insignificant patches. The mouth of gullies gaped upon us from both sides; but we were seldom able to see more than a few meters up them, for they wind excessively, and the windings are short and abrupt. A closer examination revealed the fact, that each of these gullies is the main trunk, as it were, of an entire system of smaller gullies, all related to it as the branches are to the trunk of the tree in the way shown in the accompanying sketch (fig. 12). If you follow up one of these trunk gullies, you find that it is joined by a great number of smaller gullies from each side, and these again by yet smaller ones. The bed of the trunk gully rises pretty steeply, so that a climb of one or two hundred meters suffices to bring you within measurable distance of its origin, and you perceive yourself standing on the level surface of the plain above the river. Hence it is only a relatively narrow belt of country on both sides of the river which is thus cut up by these deep ramifying gullies. One of my men who rode along the right bank, with the object of keeping us who were in the skiff in touch with the caravan, had consequently to travel a few hundred meters back from the river, where the surface was perfectly level, with the exception of a very occasional watercourse. It would have been absolutely impossible for him to ride close alongside the river. These gullies are of course formed by the local rains, which when making their way down to the river keep scooping out their channels deeper and deeper. The bottoms of very nearly all these gullies were then a little above the water-level of the river, but in only one or two of them was there any water. In the flood period however the water out of the river

Fig. 12.

must penetrate a little distance up most of them. It is owing to this that the layers of clay nearest to the river are more broken and crumbling, and consequently fall a readier prey to destruction.

After maintaining its constricted channel for no particularly great distance, the river widens out again, making room for long, narrow strips of alluvia. In some places the depth is so great, that the velocity is hardly perceptible. Here the river is joined from the right by a broad, dry watercourse, the bottom of which was overgrown with grass; while on the left there is a large gully, likewise dry, except for a pool in its throat. Some other similar watercourses come no doubt from the nearest hilly regions, though these are, it is true, a good way off. After a while the river describes a remarkably regular and wide-sweeping curve to the north-east. At the very apex of the loop it picks up a medium-sized tributary, which is unquestionably identical with an arm that branches off to the left just above Camp LXXIII.

After making a little bend to the south-south-west, the river turns due south — indeed it is amazingly straight for a river, and that in a place where one would expect an irregular delta with any number of arms, branching out all over the flat alluvial slope. The side-gullies now began to decrease in number; probably the systems of gullies that no doubt still exist on both sides make their way directly into the lake. On both banks of the river the scarped terraces are vertical and a couple of meters higher than before: at one place where we measured them they were 6.68 m. high. When they are not vertical, they are at all events so steep that it is almost everywhere impossible to climb up them. The river flowing between these escarpments still continues to bear a remarkable resemblance to an artificially dug canal, being amazingly straight and regular. The long narrow strips of sediment appeared above the water in only one or two places; but later in the year, in the autumn and winter, when the volume must be incomparably small, and the river frozen, these alluvial deposits will occupy a much more extensive area. The breadth was now increasing slowly, but constantly. At one point where the eroded banks reached an altitude of 8 meters, the breadth amounted to 400 m.; while the depth almost everywhere was about a meter, and varied but slightly anywhere. After the point just indicated the breadth increased more rapidly, while at the same time the scarped banks decreased in height. At one spot, where the breadth amounted to at least 500 m., the bank was only 55 cm. high. A few hundred meters lower down it was 25 cm.; then, but for a very short distance, 1 m.; and after that it merged into the belt of flat alluvium that forms the lake-shore, though next the river there was still a distinctly visible edge barely 1 dm. high. During the last section of the river's course the banks are perfectly barren: not a single blade of grass was to be seen, the ground being a light yellow.

If ever the term »funnel-shaped» is correctly applied to the mouth of a river, then it certainly is here, where the Satschu-tsangpo enters the salt lake of Selling-tso. Straight as a die, almost as though its course had been drawn out with a ruler, flows the river towards the south, except that at its very end it makes a slight bend towards the south-south-west, while the breadth increases to 1 km., to 1 1/2 km., to 2 km., and the banks swing away to right and left and disappear as thin yellow lines,

until they become merged in the northern shore-line of the lake. Thus instead of a delta, it forms a typical estuary.

During the latter half of the day's paddle we had to contend against a head-wind, which made the water in the river-mouth quite lumpy. For this reason we kept close to the right bank. Here we were unable to detect any movement on the surface of the stream; the current was lost partly in consequence of the very great breadth, and partly in consequence of the depth, which even close to the bank was 2 m. and more, and in the middle of the stream was even greater.

CHAPTER II.

THE SELLING-TSO AND THE JAGJU-RAPGA.

The view which unfolded itself from the point where we turned due south was peculiar and at the same time confusing. Straight ahead of us there were no signs of land, so that we were almost inclined to believe that the river emptied into a bay of the sea. In the far off distance the outlines of the shores became lost to sight in consequence of the refraction of the atmosphere. All we could make out was the range of mountains on the east shore of the lake, but it appeared not to be connected with the earth, but to be parted from it by a cushion of air which was in a state of continuous vibration; the separate parts of the mountains looked like free-standing buttes (fig. 13). And the same thing was true of the camels in our caravan as they marched a couple of kilometers west of the river; their legs were three or four times as long as they naturally are, and yet the caravan appeared to be standing still on the extensive, sun-lit plain.

Fig. 13.

At the angle where the right bank of the river merges into the northern shore of the lake there is a blunted promontory of sedimentary matter; it was then flush with the water surface and consequently possessed no eroded edge. Beyond it lay some exceedingly flat sedimentary islands. Paddling round these, we turned west and north-west in the attempt to reach the lake-shore, where some of the men were waiting for us with horses. But we found it impossible to skirt the actual shore-line owing to the remarkable shallowness of the lake on that side, the depth being barely 1 dm. Accordingly we swung out into the lake again, though the water under our skiff still continued to be muddy river water; we had to look a considerable distance to the south before we were able to see the dark blue waters of the lake of Selling-tso, at that time churned into big waves by a wind from the south. Thus the river water was predominant for as far as our range of vision extended, so that throughout the whole of that area, and it was very extensive,

the lake must be extremely shallow. We at length reached the lake shore by way of a deltaic branch, now cut off and dead, though still full of water and tolerably deep; its continuation could be detected a good distance from the shore, in the shape of a deeper channel running through the otherwise shallow northern part of the lake. There were also a couple of similar branches, but less developed. I could not however make out whether they were independent streams that originated in the nearest mountains on the north-west or whether they were — and this is indeed the more probable — actual deltaic branches belonging to the final part of the river's course, branches which become filled when the river rises exceptionally high, the water making its way over at some point or points where the right terraced bank is lower than usual. If this latter is the case, we might indeed speak of a very rudimentary and minimal delta.

Fig. 14. SCHANIG-NAGBO.

Reliable data with regard to the configuration of the lake-bottom could only be obtained by taking a series of soundings outside the river mouth. Owing to the heavy »sea» that was on, I was unable to do anything in that respect. Off the promontory which projects between the estuary and the rudimentary delta, the water was, as I have said, extremely shallow. Its colour towards the east appeared to indicate that the lake is shallow also in that quarter; in other words, a bank of deposited river-mud seemed to curve round the outside of the estuary. And its presence is rendered more credible by the fact that the fresh water radiates out to such a great distance into the lake. This acts as a kind of barrier to the salt-water, converting the river-mouth into, as it were, a basin, which during the warm season is fed by fresh water only, coming from above. Even then, when the wind was blowing hard from the south and the waves came driving in off the lake, the salt water was unable to penetrate into the river mouth. Perhaps the conditions

are different at other seasons of the year, when the river drops, though even then the lake will no doubt preserve the same level.

From the point where we landed the shore-line stretched towards the S. 53° E. and N. 86° W. To the S. 51° E. we saw a rounded elevation, which may possibly have been an island; and to the S. 19° W. there was a relatively lofty mountain. Camp LXXIV, only a couple of kilometers from the shore, lay towards the N. 53° W. In its neighbourhood was a nomad camp consisting of two tents with 12 inhabitants. These people called the locality Schanig-nagbo, while the nearest mountain to the west was Tsong-gong. As the grazing here was good, we were tempted to give ourselves a day's rest. The weather however was anything but pleasant: the sky was heavy with clouds, a couple of rain-showers fell, it lightened and it thundered, and the wind blew hard from the west. This was a sort of forerunner of the transition between too different types of weather which are both very characteristic of the autumn, namely from the rainy season to the inconceivably violent, constant westerly wind, which prevails the whole of the autumn and winter.

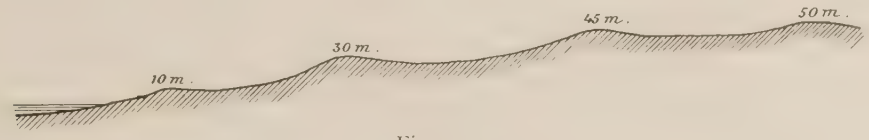


Fig. 15.

September 7th. We now proceeded west-south-west along the northern shore of the lake. The belt of barren sediment in which the delta is situated grew increasingly narrower, while at the same time it thinned away to a point, and came to an end just beyond the camp, where the vegetation reached down to the water's edge. The boundary between these two belts is very sharply drawn; it marks the outside of the area which becomes inundated when the river rises especially high, and on which it drops its new alluvium. Farther along, the edge of the lake is bordered by only a very narrow strip of barren ground. Here we had, fairly close to our right hand, a minor stretch of cliffs, extending from east-north-east to west-south-west. Their south-eastern face is precipitous, while the opposite or north-western slopes down relatively slowly. On the left we passed a blunt-ended peninsula, containing a number of lagoons, marshes, and bays. The water in the lagoons was fresh, so that it must be derived from springs. Close beside these the grazing was especially thick and good, the grass being half a meter high. Here there was a large herd of orongo antelopes.

Next we approached a rather capriciously outlined part of the northern shore, a broad peninsula of an unusual shape, projecting south. Its southern face is fairly straight, and is crowned by a line of steep and rugged cliffs, which terminate towards the east in a point or pier-like continuation, studded with detached pinnacles of rock. Those on the outside of the line even appeared to rise above the water like islands, unless it was a mirage caused by the refraction of the air. This eastward projection gives rise to a bay of especially regular formation, its shore sweeping round in almost a complete circle. Above the existing shore-line we noted at different elevations four older strand-ramparts, all exceptionally beautiful and very distinct; they run parallel with each other and with the shore. They are best deve-

loped in the middle; but at the north end they recede from the water's edge, and become flat and indistinct; in fact, it is only the highest of the four that could be followed all the way up to the foot of the little range mentioned above. I estimated their several altitudes above sea-level at 10, 30, 45, and 50 m. respectively (fig. 15). These strand-ramparts consist of barren gravel, though a little grass was growing in the hollows between them; yet they did not embrace any lagoons. The summit of the highest terrace commanded an excellent view of this attractive and beautiful scene. Close at our feet were the strand-ramparts of which I have been speaking, which by reason of their situation, their shape, and their regularity put me in mind of the benches in an amphitheatre. The lake extends its greatest length towards S. 79° E. The water was blue and limpid. In the far off distance were smaller mountain-ranges. The summit of the highest rampart is at the same time the highest part of the peninsula; it forms as it were a flat platform, although upon a closer examination its relief turned out to be rather capricious. We crossed it diagonally towards the south-west, for at that time we had no idea that we were on a peninsula. As we proceeded we passed on the right the slope of a terrace, which inclines towards the north-west and marks the position of an older bay. In about the middle of the peninsula rises a small and quite isolated butte of brick-red sandstone, and south-east of it lies a curious hollow in the ground, an elliptical area, with its longer axis stretching from north to south. The surface inside its periphery inclines evenly and regularly towards the central depression, and at the bottom of this were some small freshwater pools surrounded by good grazing. Here we found a nomad encampment with flocks of sheep. The bottom of the depression was a good deal higher than the then existing level of the lake. During the course of our further march towards the western extremity of the escarpment-range that barred our path, we passed eight other strand-ramparts of the same kind as the first-mentioned, only smaller. Below the lowest of them was an elongated lagoon. The escarpment-range in front of us, the western end of which I had already reconnoitred, presented some magnificent scenery. Its flanks are practically everywhere vertical and at their base great masses of detritus have accumulated, making the southern shore of the peninsula gravelly and difficult to travel on. Altogether it was like a cyclopean wall.

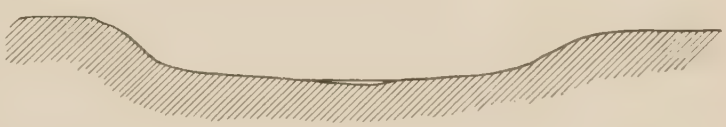
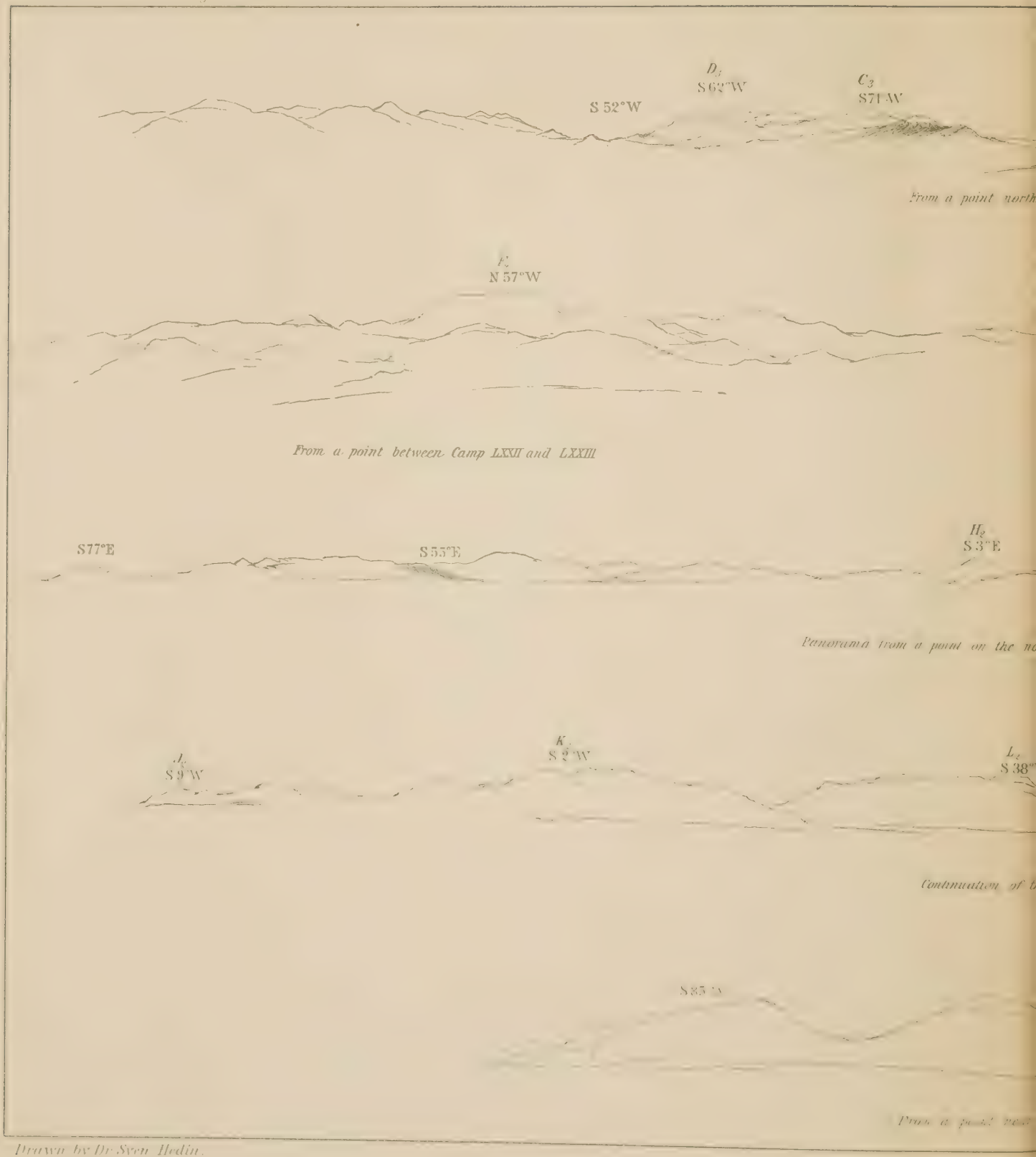
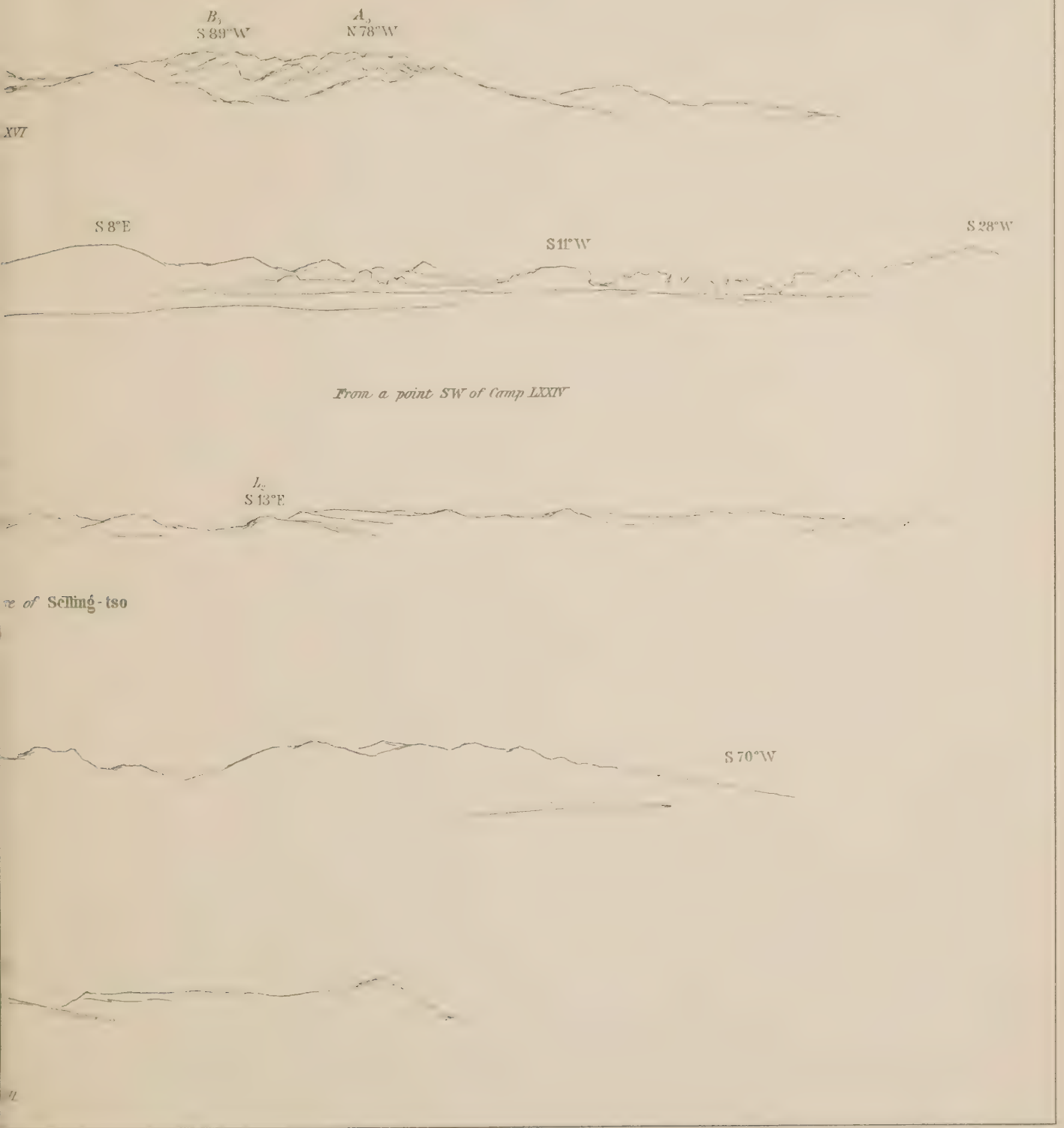


Fig. 16.

Thence we marched north-north-east to a district called Tang-le, where we found one or two nomad tents beside a couple of freshwater pools near the shore of the Selling-tso. The western shore of the peninsula is flat and marshy and very irregular, being broken by numerous bays and promontories. In several directions we saw a number of small lagoons. The only place in which we came across strand-ramparts as distinct and as beautiful as these was the isthmus between the Selling-tso and the Naktsong-tso. Generally they are either indistinct or are altogether



Drawn by Dr Sven Hedin.



From a point SW of Camp LXXIV

e of **Selling-tso**

From a point at the northern shore of Naktsong tso

From Camp LXXVIII.

From the

Scra Gnads Ram

Drawn by Dr. Sven Hedin.

Generalstabens litografiska Anstalt, Stockholm.

absent, for the shores of the lake are usually very flat and the lake itself very shallow next the shore, and it is only where the slope is somewhat steep, as at the two places mentioned that these ramparts are distinctly perceptible. Nevertheless they afforded a clearer proof than anything I had yet seen, that the lakes in Tibet

Fig. 17. THE PENINSULA ON THE NORTHERN SHORE OF SELLING-TSO.

are shrinking. Selling-tso is contracting at a rapid rate. Along the existing shore the beat of the waves — and in a lake of the size of the Selling-tso they are capable of exercising a considerable effect — is busy building up a fresh rampart of the same character. Of the older ramparts it was easy to see that the highest

and oldest is the most powerfully developed. It might indeed have been expected that this, just because of its greater edge, would have been obliterated, or at any rate more broken down than the others; but on the other hand it dates from a time when the lake covered an incomparably greater area than it does now, and when consequently the force of the waves was immensely more powerful and violent. The medium-sized gravel of which the ramparts consist will also offer stubborn resistance to the atmospheric agencies. If we suppose the surface of the lake raised to the level of the highest rampart, which I estimated at 50 m., it

Fig. 18. WESTERN EXTREMITY OF THE ESCARPMENT-RANGE OF THE PENINSULA.

would inundate all the adjacent low-lying country, and especially the whole of the lower part of the broad valley in which flows the lower Satschu-tsangpo. Even Camp LXXII, although 24 km. distant from the existing lake and only a few meters above its surface, must then have lain in a considerable hollow, and above it the lake must moreover have sent out a large bay to the north and north-east. Indeed the whole of the alluvial region below this camp must have been under water even at the time when the lowest strand-rampart was formed. For this reason alone it would be idle to search for traces of former beach-lines. And even though beach-lines had been left behind by the lake as it slowly retreated, they would have been unable to maintain themselves for long in the loose clay which we found so seriously attacked in the gulleys close beside the river, especially considering that the rain is powerful enough to obliterate every trace. At the time the lake rose to the level of the highest rampart, the great peninsula which I have mentioned would be connected with the mainland by only an extremely narrow isthmus; while at an even earlier period it would be entirely cut off from it. Indeed it is possible to conceive of a time when the escarpment-range of the peninsula and the little detached sand-

stone butte formed steep craggy islands, similar to those which we subsequently encountered in the Tschargut-tso. The elliptical hollow that I have spoken of will formerly have been filled by a small disconnected lake. I shall discuss the hydrographical importance of the Selling-tso when I deal with its neighbour lakes. Its water was bright as crystal, although salt, the sp. gr. being 1.0263 at a temperature of 7.2°, though during the course of the day its temperature rose to 17° along the shores.

During the course of the morning it hailed twice so violently that we had to halt, and from 1 p. m. until evening it rained incessantly; yet so fine and spray-like was the rain that the ground was not appreciably softened, though this was rather the consequence of its firmer consistency.

Fig. 19. TIBETANS AT JAGJU-RAPGA.

On the 8th September we continued towards the west, travelling along the shore, for the ground there was hard and level, and afforded excellent going. Unfortunately the violence of the wind and the roughness of the water prevented me from rowing across the lake as I had wished. Between the west shore of the great peninsula and the northern shore of the lake there was a bay, which we had to go round. After that the lake-shore was particularly even, having only a few insignificant headlands. The scenery continued to be on the whole monotonous, although to the south the view was of such a character that I never grew tired of studying it, namely the beautiful lake with its waters now tinged with green, and in fact the Selling-tso is one of the very largest lakes in Tibet. I only touched its northern and western sides, but according to Littledale's map the main body of the lake must reach a good long way towards the east and there form a vast basin. In shape it is more circular than the majority of the lakes of Central Tibet, for by reason of the orographical conditions most of them extend from east to west. As

for the Selling-tso, if one may judge from the small broken mountain-ranges which form peninsulas and promontories round its shores, it would appear to belong orographically to two different latitudinal valleys. The panorama of the mountains, which unfolded itself when seen from that part of the northern shore along which I

Fig. 20. TIBETANS AT JAGJU-RAPGA.

travelled, is reproduced in an accompanying illustration. In the extreme west is seen the nearer mountainous peninsula of the Jagju-rapga and in the extreme east the broad peninsula with the escarpment-range, which orographically may indeed be regarded as the continuation of the former.

All along the northern shore we encountered old strand-ramparts, remarkably distinct, though not so beautifully developed as those on the peninsula. Here however I observed only two, and for a considerable distance we rode along the lower one, which offered a track in every way as good as an asphalted street. Our view towards the north was generally obscured by the upper rampart, though a long way off in that same direction we beheld the mountain-range which may be regarded as the northern boundary of the northern latitudinal valley of the Selling-tso. The little irregularities of the shore-line, namely the few blunted headlands, all consist of fine sediment and are very low. The biggest is triangular in shape, and along the line of its southern continuation rises, at some kilometers from the shore, a low mud island. Quite close to this little peninsula a thin bed of red conglomerate cropped out at 57° to the N. Conglomerate and sandstone are the prevailing rocks of that region. At the point where the lake terminates in a bay, the point where we turned towards the south-west, a little isolated mountain of a red colour, conglomerate and sandstone, rises quite close to the shore. In that locality only one strand-rampart was distinctly developed, and on both sides of it, on the inside next the lake and on the outside, were several small freshwater lakes, those on the inner side beautifully dammed back by the rampart. Each pool was deepest close in under the rampart.

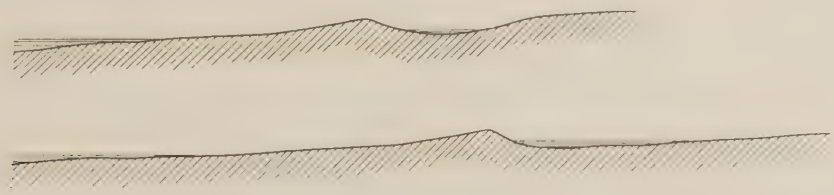


Fig. 21. RAMPART WITH POOL ON THE NORTHERN SHORE OF SELLING-TSO.

In the west-south-west appeared the entrance to a broad glen, and out of it flowed a river, the mouth of which we were approaching. The shore now jutted out into a peninsula formed entirely of sedimentary matter and having a couple of pools at its base. Immediately on our left we now had a labyrinth of smaller sheets of water, all connected with the lake; at first I thought they belonged to one of its bays. But as the water in them proved to be fresh, they could only owe their existence to a river, nor was it long before we came upon it; furthermore, as its water was as bright as crystal, it was pretty safe to infer, that the river issued from another lake situated farther to the west and serving as a clearing basin to it. The correctness of this inference was soon afterwards established, and with it the incorrectness of Bower's map. We were fortunate enough to strike an excellent ford, where the bottom consisted of hard tightly packed gravel; in fact in this region we were nowhere troubled with boggy ground. We pitched Camp LXXVI on the right bank of this river, the Jagju-rapga, a few meters above the surface of the Selling-tso, the altitude of which is 4611 meters.

The grazing here was poor. The river flows from the S. 67° W. just before entering the lake and its broad latitudinal valley lay open in that direction. The scarped bank of the stream, against which the current pressed, was below our camp

vertical and more than 2 m. high. It was built up of sand and gravel-and-shingle. The river was generally deep and its bed energetically cut out. Nowhere along the existing terraced banks were we able to detect lines or marks of higher water-levels. This circumstance again is proof of the existence of another lake to the west, which empties itself by this river into the Selling-tso, and at the same time serves as a regulator of the issuing stream. On each side of the river was a dry channel; these I took at the first glance to be chance branches of the river itself; but it turned out that they originate in the nearest mountain-ranges.

Fig. 22. CAMP LXXVI.

At the point where we forded the river — and this if it was not the only ford in the lower part of the river was at any rate its best ford — it was however divided into two arms by a long, narrow gravelly island. Below this island the river broadens out into a bay of irregular and capricious outlines, and a great number of low mud-banks and islands. The presence of this fine material was rather a surprise, for the current was absolutely free from all particles of matter, while the bottom above the gravelly island likewise consisted entirely of gravel. It might indeed be supposed that the river would be joined at its very mouth by torrents that rush down off the adjacent mountains after heavy rain, carrying with them quantities of sediment, which subsequently settles in the tranquil waters of the river-mouth; but it is more reasonable to suppose, that what now appear as mud-banks and islands were originally nothing more than relatively higher parts of the lake-

bottom, portions which have been shaped and left in relief by the currents set up in the lake by the discharging river. And as the lake level drops so do these upstanding portions of the former lake bottom become increasingly visible. Beside these alluvial islands the depth amounted to 2 to 3 m., and thus here, in the very throat of the river, it was somewhat greater than in those parts of the lake which lie just outside of it. Immediately below the gravelly island the water was slightly saline, owing to the intermingling of the river water and the lake water. Yet throughout the whole of the large bay into which the river empties the salinity is considerably less than it is for instance beside the broad peninsula or in the southern part of the Selling-tso, where no river enters the lake. In this bay we also found enormous quantities of a small Crustacean, which Prof. Leche has identified as *Daphniopsis tibetana*. Farther out in the lake we did not observe this little creature; there the water is no doubt too salt for it.

The presence of vast flocks of gulls as well as of wild-duck all over the estuary region suggested that the river also contained fish; and indeed there was a great quantity of fish just above our camp. Unfortunately the specimens that I took to bring home with me got lost; but they could only be species of either *Nemachilus* or *Schizophygopsis*, for these are the species we found in several other parts of Central Tibet living under precisely similar conditions. One kilometer above the camp the river breaks twice into cataracts, and it was at the foot of these that the fish were disporting themselves. We caught a large supply by means of nets; they had an excellent flavour. Curiously enough the Tibetans have as great an abhorrence of fish as they have of snakes and lizards.

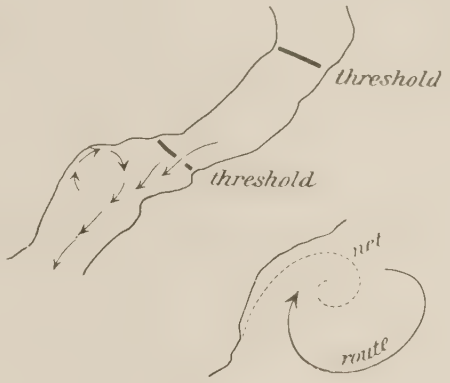


Fig. 23.

The point where the cataracts occur is of great interest. The river forms there a double bend in the form of an **S**, and its bed is deep and narrow, especially below the rapids, of which the upper one was nearly 1 m. high and the lower one only 0,3 m. The bright water pours in a solid mass over two thresholds or sills formed of firmly cemented gravel-and-shingle and of argillaceous mud. Opposite the lower the right bank of the river is about 3 m. high, while the left bank slopes gradually up to the general level of the adjacent country. The thresholds are deeply cut down below the surface, so that it is impossible to detect whether they are continued on the land sides. But by following up the left bank of the river, we found in the lower part of the valley of the Jagju-rapga, and on the east side of a swelling buttress that juts out from a mountain-range there is there, no less than seven distinctly marked old beach-lines or ramparts, consisting of gravel. They are all parallel to one another, and turn their concave sides towards the great bay of the Selling-tso, into which the river empties itself. From the lowest of these ramparts the shore slopes gently and regularly down towards the lake, without showing the slightest indication of either rampart or terrace. Yet we might reasonably regard the two

thresholds which lie athwart the stream as a variety of modified shore-line, which owe their existence to the shrinking of the lake; so that they furnish yet another proof that this lake actually is contracting in area. Nevertheless it would be incorrect to compare the recently mentioned strand-ramparts with these thresholds; the

Fig. 24. FISHING IN THE JAGJU-RAPGA.

two sets of phenomena are quite different. For at the time when the Selling-tso shrank so as to touch only the lowest of the seven ramparts, the thresholds in the river-bed were situated a considerable depth below the level of the lake. They are no doubt underground sandstone ridges in the lake basin, now for

A TIBETAN AND MY LAMA.

Liustr. A. B. Lagrelius & Westphal.

TIBETAN CAVALRY.

the most part filled with soft disintegrated material, and indeed they do exhibit the same character as the numerous sandstone ridges which we found in the lowest part of the Satschu-tsangpo. But they are also instances of the effects of erosion. In general the Jagju-rapga has a fairly insignificant fall, and the difference in altitude between the Tschargut-tso and the Selling-tso cannot amount to more than half a dozen meters.* The velocity is, it is true, rather high, but as a rule the current flows silently and without breaking into cataracts. It is only at the two thresholds — and possibly there may be several others like them higher up — that the velocity is increased, the erosive power of the current being intensified to its greatest conceivable limit; hence the threshold must keep travelling backwards up the stream in the direction of the Tschargut-tso. But that they also constitute a proof of the contraction in area of the Selling-tso is clear enough, when it is borne in mind, that in case the lake were to drop yet one or two meters more, there would inevitably come into existence, at the foot of the lowest threshold, either a series of cataracts or a new threshold with a new cataract at some ridge of hard rock across the river.

Fig. 25. FISHING IN THE JAGJU-RAPGA.

Close to the camp I measured the volume of the Jagju-rapga, or Selling-tsangpo as some of the Tibetans also called it. Its breadth was 36.4 m.; its mean depth, 0.56 m.; mean velocity, 1.269 m.; and volume, 25.9 cub.m. per second. In consequence of the fact which I have pointed out above, namely the part played by the Tschargut-tso, and in a still higher degree by the Addan-tso, which lies farther to the west and possesses an extensive drainage-area, we may take it that this volume of 26 cub.m. is fairly constant, and subject to only minimal variations during the

* In the Meteorological Section the altitude of the Tschargut-tso is given as 4607 instead of 4617 m.

course of the year. Both these lakes, the Tschargut-tso and the Addan-tso, are no doubt covered with thick ice in winter, and after the cold season has set in in the circumjacent mountains the inflow into the two lakes will be reduced to the smallest possible amount. But on the other hand these two lakes are so extensive and so deep that the Jagju-rapga might well continue to flow for a considerable time without causing any appreciable drop in the ice-bound lakes. Add to this the probability that both lakes may be fed by a countless number of subterranean springs, all of which help of course to maintain them at the same constant level. In any case it is conceivable, that even during the long winter the drop which takes place in the river is extremely slight, or perhaps there is no noticeable drop at all. Marks on the eroded banks prove conclusively, that the river could not rise higher than the level at which it stood on 9th September, but it *could* of course be lower. In that case, the river would at the period of our visit be standing at its highest level, in consequence of the upper lakes having been filled with rain-water during the past summer. I think it most probable however, that the oscillations of level have a rather small range.

The volume of the Jagju-rapga was barely half as much as that of the Satschu-tsangpo a few days earlier (56.5 cub.m.). The latter was however dropping, and it would not be long before it dropped to the same dimensions as the former. But whereas the Jagju-rapga would remain constant during the winter, the Satschu-tsangpo would continue to shrink until it reached an exceedingly low ebb. In other words, the Jagju-rapga is active all the year through, while the Satschu-tsangpo confines its activity to the rainy season, but at all other times, and especially during the cold period of the year, leads a moribund existence. When you consider the enormous quantities of water that the Satschu-tsangpo pours into the Selling-tso during the rainy season, you are inevitably driven to the conclusion, that, taking the year as a whole, this river yields on the average a far greater tribute to the lake than does the constantly active Jagju-rapga. And a superficial estimate is enough to confirm this: if the Jagju-rapga contributes to the lake a constant volume of 26 cub.m. in the second, it will pour into it during the course of the year a total volume of 820 million cubic meters; if the Satschu-tsangpo pours into the lake 150 cub.m. in the second for the space of three months, that makes a total for the year of 1100 million cub.m. And even though this figure, 150 cub.m. in the year, be too high, the amount which flows down the river during the remaining three-quarters of a year will be sufficient to bring up the total volume to 1200 million cub.m. The Jagju-rapga will therefore be only two-thirds as big as the Satschu-tsangpo.

Besides these two rivers I saw only one other entering the Selling-tso, namely the Alan-tsangpo, and it carried on 10th September a volume of 7 cub.m. So far as I touched the southern shore, the lake received no affluent on that side, except perhaps subterranean affluents, and Littledale found no river on the east side. All the same during the rainy season the lake will certainly be entered by a number of temporary tributaries from all sides. The drainage-area of the Selling-tso is particularly extensive; indeed of all the self-contained drainage-areas of the Tibetan highlands, there is only one, namely that of Kum-köl, that can compare with it. Since however the lake is now shrinking, it is fair to infer that the amount of

rainfall over its drainage-area is diminishing. It is however of course impossible to say how far the shrinkage is permanent, although it is probable that it is so. The farther we travelled west, during the further course of the journey, the more evident were the signs of higher lake-levels having existed at former dates, and consequently the greater was the extent of the shrinkage. In the case of the Selling-tso I estimated that the highest rampart was about 50 m. above the present level of the lake; subsequently I came across similar ramparts, at Lakor-tso, at a measured height of 133 m. above the existing lake-level. In the case of the lakes situated farther west, the old beach-lines are best developed on the sides that face west and are exposed. In the case of the Selling-tso however they appear to be developed most distinctly on the shore that faces east. This may possibly be caused by different wind relations; but I am not in a position to make any comparison in this regard, for I have not visited the eastern side of the Selling-tso, and old strand-ramparts *may* be developed there to an even greater extent than they are on the northern and western sides of the lake. It is most probable that the same winds prevail here that prevail in western Tibet.

September 10th. At the very beginning of the day's march I had an opportunity to observe a peculiar form of surface, which is also undoubtedly connected with the shrinkage of the lake. On the south side of the valley of the Jagju-rapga rises a chain of craggy heights, not very lofty, but serrated and capricious. This chain grows increasingly lower towards the east and terminates in a rocky headland jutting out into the lake. Immediately south-east of Camp LXXVI there exists a gap or breach in the adjacent range. In the throat of this rocky gateway, through which we obtained an extensive view towards the south there rises a ridge, about 40 m. in height, composed exclusively of hard, compacted gravel and having a relatively steep slope towards the north. On the top it is flat as a platform; the slope that reaches towards the south is both less steep and less high. The entire ridge thus constitutes a broad rampart, stretching in a sinuous line from east to west. At its northern foot was a pool or lagoon, at that time not exhibiting any visible connection with the bay of the Selling-tso, from which it is only separated by a very low ridge. Immediately south of this and parallel with it runs a second ridge, presenting in the main the same characteristics as the first one. The only difference between them is that the second ridge turns its steeper face towards the south. Between the two lies a depression, which contained a pool; and between the southern ridge and the western wall of the rocky gateway there exists a well-marked watercourse. Now these two ridges are beyond doubt old beach-lines, although in default of an exact levelling it is difficult to make out clearly their former position in relation to the lake. I dare say that they formed together a narrow peninsula, with a lake in the middle. Possibly too the deep watercourse may have been a narrow sound, in which case the eastern part of the mountain-range would be entirely separated from the western part. Immediately south of the rocky gateway lies a third pool, bigger than the other two

The rocky walls that frame in this mountain gateway are steep and picturesque; the rocks, which consist of the same varieties as the escarpment-range in the broad peninsula, dip at an angle of 46° N. It is perfectly evident, that these

two separated masses belong to one and the same range, a fact witnessed to by their external configuration, and the east and west extension of their peninsulas, crowned with denticulated peaks and pinnacles. This was the character of the mass which rises east of the rocky gateway. Both north and south of that point the lake forms bays, though the one to the south does not indeed penetrate very deeply. As for the western continuation of this range, we shall encounter it when on our way to the Tschargut-tso.

Eagles were circling round the bare rocky walls and there also rock-pigeons were flying about. Ravens were numerous, and, as I have already mentioned, gulls and wild-duck at the mouth of the river Jagju-rapga. Thus the avi-fauna of the region was exceptionally well represented. There were also great numbers of kulans, and they were far less shy than those that we saw on the uninhabited plateaus. Occasionally too we observed small flocks of orongo antelopes.

To the south of the broken range stretches a level plain, with an imperceptible slope towards the west shore of the lake. This plain is traversed by the river Alan-tsangpo, which was then carrying a volume of about 7 cub.m. of perfectly limpid water. At the point where we forded it, it was split into two branches, each with a hard gravelly bottom. A couple of tents were standing on the left bank, close to the mouth of the river in the Selling-tso. From that point we beheld to the south-west a chaos of mountains, in which it was not easy to make out any sort of arrangement. They appeared to be the outliers and ramifications of some bigger central mass rather than offsets of the usual parallel-ranges. Between them several glens open out upon the very broad plain which skirts the Selling-tso on that side. Two of these are especially large and it will be from them that the Alan-tsangpo no doubt derives its chief supplies of water. In the S. 85° W. we perceived the end of the latitudinal valley which is situated at the southern foot of the range containing the rocky gateway. Probably this valley too will make an appreciable contribution to the volume of the river. On the south-west horizon rose the great snowy range which we had long had in sight. In that direction there appeared to be no possible route by which a camel caravan could travel, whereas to the south-east the country was both inviting and excellent for marching.

During the last few days the weather had been very unsettled, sometimes warm and sunny, sometimes hail and rain, with a fierce wind from the west. No sooner had we got across the river than another storm burst; the entire country was enveloped in a thick haze, making it almost as dark as midnight, and the hail and rain came down in torrents. In fact we were only able to advance with the help of the compass, for not a single glimpse of either mountains or lake was to be seen. This again softened the ground, which consisted of blue clay intermingled with sand. It became exceedingly treacherous and dangerous, and we were even forced to turn back by marshes of great extent. In one or two places, where the grazing was good, we observed nomad tents. Not far from the last of these we descended a distinctly marked strand-terrace, situated 2 to 3 km. from the present shore of the Selling-tso. At its foot too there were again water-logged marshes and several pools with open water, on which vast numbers of wild-geese were

CAMP LXXVII.

LOOKING N.E. FROM CAMP LXXVII;
MOUNTAIN-RIDGES BETWEEN SELLING-TSO AND NAKTSONG-TSO.

disporting themselves; there too were several orongo antelopes. In one or two places we saw tame yaks and flocks of sheep; but the grazing on the plains beside the lake was not in general particularly good, the only place where the grass was at all luxuriant being close beside the marsh. In the vicinity of Camp LXXVII at an altitude of 4665 m. or 54 m. above the level of the lake, there was also a marshy accumulation of water, and down into it ran all the smaller rainwater brooks off the relatively low slopes to the south. The above mentioned littoral marsh however lay only one or two meters above the level of the lake and owed its origin to freshwater springs. It would require only a very slight elevation of the lake's level to put a considerable proportion of this extensive plain under water. Close to the camp we passed on our left a distinct, but detached, butte, of the same appearance as the mountain-range in which is the rocky gateway that I have spoken of. After a short delay in the rain, we again obtained an extensive, and at the same time impressive, panorama across the Selling-tso towards the east, for in that direction the lake appeared to stretch to an immense distance. The panoramic view of the shore-line which I sketched, and herewith append, was taken from a point beside the marsh. It was easy to recognise again the pronounced features of the country which we had just left behind us, especially the conspicuous rocky gateway to the north-west, and the escarpment-range of the broad peninsula.

CHAPTER III.

THE NAKTSONG-TSO — EAST AND SOUTH.

The circumstances under which I travelled through this part of Tibet made it impossible for me to gather reliable information. The Tibetans were all the time doing their utmost to induce me to turn back, nor was it in any way to their interest to give me information. Armed bodies of Tibetan horsemen hung upon the skirts of our caravan; but as they took care not to point out to us the best roads, we were often forced to make unnecessary detours. Nor are the names which they occasionally gave me to be implicitly relied upon. For instance, the mountain-range with the rocky gateway was said to be called Jagju, and the promontory to the east of the gateway Tsebguk. To the mountainous country south-west of our route they gave the name of Bogar-dscharingo, and to the lofty snowy range in the same direction the name of Majo-käivi-dogdsching; while the spur south-west of Camp LXXVII was called Tsiding and the isolated mountain-mass to the east of it Danger. Farther south there is said to be a large river known as Tschungö-tsangpo, but of its existence I had no opportunity to convince myself. That such a river does exist cannot be doubted, because the nomads in the camps that we passed spoke of it; but I was unable to ascertain whether it empties into the Selling-tso or into the Naktsong-tso, or whether it belongs to some other basin still farther south.

On 11th September the Tibetans gave us no better guidance than they had done hitherto, and we had to find our way past the Naktsong-tso as best we could. First we aimed south-east, so as to cross over the low isthmus that separates the plain on the west of Selling-tso from the Naktsong-tso. There the altitude was 4693 m., or only 82 m. above the Selling-tso. About half-way between Camp LXXVII and the highest point in that isthmus or ridge there is an old shore-rampart, beautifully and regularly formed, curving like a bow and turning its convex side towards the south-east. This rampart makes a fresh link in the chain of older beach-lines that I found still existing on the western shore of the Selling-tso. The distance between the nearest point of the present shore-line of the lake and the old shore-rampart amounts to 6 km., and demonstrates the extent to which the lake has shrunk; and that the shrinkage has taken place relatively recently is evident from

the well-preserved condition of the rampart. A few days later on this same narrow isthmus between the Selling-tso and the Naktsong-tso I observed no fewer than seven similar beach-lines, and with one of them the rampart of which I have been speaking is connected.

Fig. 26. VIEW LOOKING SOUTH FROM THE NORTHERN SHORE OF NAKTSONG-TSO.

From the isthmus we had a magnificent view towards the east — the Naktsong-tso with its picturesque girdle of mountains and its expanse of bright blue limpid water. At the first glance I could hardly believe but that it was connected with the Selling-tso, but as soon as I reached its shore I saw clearly that it was another lake. Its water was as fresh as spring-water and contained Algæ. The question that now faced us was, whether we should go round it by the western shore or by the northern. It was evidently the same lake that Bower places south of his Garing Cho. But with regard to its shape and its situation Bower's map was not of the slightest use; for, in the first place, Bower only touched one part of it, and, in the second, his map is drawn on far too small a scale, so that from it it is impossible to draw any even the broadest inferences. He also was compelled, as I was, to turn back on the southern shore of the Selling-tso, and to go back by the way he had come, namely to the Tschargut-tso. The only thing that his map showed as beyond a doubt was that he had travelled between the Selling-tso and the Naktsong-tso, notwithstanding that the shape of the latter is distorted to such an extent as to be unrecognisable.

A hurried reconnaissance southwards along the western shore of the lake showed that it would not be possible to travel that way with camels, at least not without great difficulty and making wide detours. Accordingly we turned back and travelled along the northern shore, passing round the beautifully curving bay, which swells out northwards towards the Selling-tso, and then kept principally towards the

east; but as we faithfully followed the lake-shore, our course was painfully zigzagging. Thus we had on the south the Naktsong-tso and on the north the insignificant, and not perfectly regular, mountain-range which stands on the isthmus between the two lakes. This range sends out various spurs towards the south, while close to the shore there are several more or less free-standing buttes. On the northern shore two peninsulas are especially conspicuous; the one to the east is the more pronounced, and the mountains that stand upon it compelled us for a short distance to travel even south-west; as its continuation to the south-west it has a little hilly rocky island. At the head of the bay between the two peninsulas there were a couple of lagoons, with good grazing round them. South of the eastern peninsula,

Fig. 27. ALONG THE NORTHERN SHORE OF NAKTSONG-TSO.

and tolerably near to the shore, are three or four islands, consisting of soft materials, though they reach a considerable height above the lake, in shape resembling loaves of bread or dolphins' backs. They were clothed with thick green grass; in summer it is secure from the sheep of the nomads. On the other side of the last island the lake appeared to terminate in a very extensive, but beautifully rounded, bay, bounded on the south by a mountain-spur that projects westwards and has as its highest summits the peaks which I have called L_2 and M_2. The shore round the bay was hard and excellent for marching on, as it consisted of consolidated gravel a centimeter in diameter, round, polished, and light in colour. At the distance of one or two score meters from the water's edge is an especially beautiful and regularly formed shore-rampart, which would seem to owe its existence to the beat of the waves and the grinding of the ice. Within this rampart we found, first, a large triangular pool, squeezed into the mouth of the glen that opens out between two projecting buttresses; then a couple of long, narrow lagoons, to which the rampart

TIBETAN VISITORS AT CAMP LXXVIII.

LOOKING N.W. FROM CAMP LXXVIII;
NORTHEASTERN SHORE OF NAKTSONG-TSO.

Ljustr. A. B. Lagrelius & Westphal.

TIBETAN CAVALRY.

itself acts as a dam. We stopped for the night at the head of the bay, quite close to the shore, in a locality where there was grazing, and also a nomad encampment.

Thus by following the shore-line we had made a considerable detour; for we found out that the Tibetan cavalry who accompanied us had pursued a more northerly route amongst the minor mountains on the isthmus between the two lakes. On our way back, as it was now the Tibetans' interest to show us the best road, they guided the caravan by that nearer track and took it through a country that was easy, though broken. This was, I have no doubt, the road by which Bower travelled, for according to his map he proceeded at some distance from the lake. That he was unable to form any idea as to its shape and extent is quite excusable;

Fig. 28. THE SAME.

for to see Naktsong-tso from its northern shore only is to be bewildered by the picturesque, yet confusing, panorama that it presents, and a mere hasty glance of that kind is not sufficient to unriddle its topographical secrets. Indeed I was at this time only able to map with any degree of certainty the country in my own immediate vicinity, that is the contiguous northern shore. But I thought that the lake extended very much farther to the south, and was a good deal bigger, than it afterwards proved to be. There appeared to be true fjords, like those of the west coast of Scandinavia, penetrating to the south and shut in by precipitous cliffs. At intervals hilly islands seemed to rise above the bright blue waters, and capes projected into the lake from every direction. All this entrancing scenery was quite confusing, and made me imagine that the topography of the lake was a good deal more complicated than it really is.

In the south-west immense mountainous masses, capped with perpetual snow, towered up above the tops of the nearest ranges. We did not see any

glaciers, though possibly there are some in a rudimentary stage. It was not possible to arrive at any sure conclusion as to a former glaciation of this region with far-reaching glacier-arms, which could have scooped out this lake; at all events I failed to discover any traces of it. There were neither striations on the hard rock, nor erratic blocks, nor moraines; not even the smallest flattened rampart that could be regarded as the remains of an ancient moraine. Nevertheless the bare rocks frequently showed a tendency to rounded forms, such as might have been produced by a progressive glacier-stream. As a rule, the mountains in the vicinity of the lake are covered with disintegration products and soft grass-grown earth, and usually the bare rock crops out only at the crests and culminating points in the form

Fig. 29. NORTH-EASTERN END OF NAKTSONG-TSO.

of ridges and steep masses or pinnacles and denticulations, these last showing clearly that they were not formed by ice, but, on the contrary, if the region was glaciated, must have projected above the icy covering like *nunataks*. Now since, as I shall show in a special chapter lower down, all the lacustrine regions of Tibet occur in close proximity to the loftiest and biggest mountain-ranges, it is impossible to avoid the impression, that the origin of these lakes is in some way or other connected with the snow and ice which gather on those mountains, and since moreover most of these salt lakes are undergoing a process of desiccation, it is a pretty obvious inference, that the rainfall must formerly have been far more abundant than it is now. Those portions of the mountains which ascend above the limit of perpetual snow would then be in a position to give rise to immensely more extensive and more prolific *firn*-fields than they are now, and consequently to incomparably greater glacier-arms. It is not however necessary to suppose that the entire country was under glaciation. Even to-day it is the rarest thing possible to find a mountain-

range that is continuously covered with perpetual snow for any considerable distance. Even in the Arka-tagh, which carries relatively the heaviest burden of snow of all the Central Tibetan ranges, glacier-breeding swellings are very rare; they rise only here and there at wide intervals, while the crests of those parts of the ranges which intervene between these swellings are sometimes even quite free from snow. Nor are there in the interior of the plateau any ranges that bear continuous glaciers: such glaciated masses as do occur there rise above the plateau like disconnected islands. Probably one such glaciated mass was situated in the mountainous tracts between the Tschargut-tso and the Naktsong-tso on the one side and the Kiaring-tso and Mokju-tso on the other.

Fig. 30. BURIAL OF ONE OF MY SERVANTS ON THE SHORE OF NAKTSONG-TSO, CAMP LXXVIII.

These are the first general impressions suggested by the sight of Naktsong-tso. Before I proceed to a more detailed description of the lake's topography I have only one short day's march to deal with, namely that to the point at which we turned back in this short burst to the south. Beyond Camp LXXVIII the country was open to the east. The surface rises first towards a very flat threshold, and afterwards sinks down to the shore of Selling-tso, which just there is quite close. Hence a very considerable part of the Selling-tso stretches out into that quarter, and according to the maps made by Bower and Littledale, who visited the southern and eastern sides of the lake, the Selling-tso is in point of area but little inferior to the Tengri-nor, and consequently is the second largest lake of Tibet. On the

isthmus there were two small pools, and from our line of march we beheld in the Selling-tso a flat, white-gleaming island, situated close to the shore; however, as we saw only one-half of it, it may possibly be a peninsula. The range which borders the isthmus on the south is likewise broken by a »gateway», with a little threshold in it, at an altitude of 4695 m., and through this natural gateway we had to the south a fairly open and extensive view — a latitudinal valley, the bordering mountains of which were at a considerable distance to the south as well as not particularly high. We passed on our right the two peaks L_2 and M_2, which are situated

Fig. 31. ONE OF THE EMISSARIES FROM LHASA.

on a blunted peninsula that juts out into the Naktsong-tso. The range with the »gateway» in it bears a very close resemblance to that beside the Jagju-rapga. Its southern face is precipitous. We now travelled south-south-east, without seeing a glimpse of either lake, though on the north side of the range these two sheets of water are by a long way the most conspicuous features in the landscape. Camp LXXIX was pitched on the west side of a fairly extensive marshy region, where the grazing was good; its altitude was 4674 m. At this point I was stopped by the Tibetan cavalry and prevented from advancing farther south; and it was from this point therefore that I made my real start for the west — for Ladak.

On 14th September I set off on a three day's boating excursion on the southern and western parts of the Naktsong-tso, and it is to this that I owe the good general idea I obtained of the shape and bathymetrical relations of the lake. It

took us an hour's ride towards the west-south-west to reach the lake-side. The point at which we struck it was a rather wide bay, lying between the mass M_2 and the nearest not very accentuated mountain-masses to the south of it. The ground consisted of sand and fine gravel and the shore plunges down rather abruptly

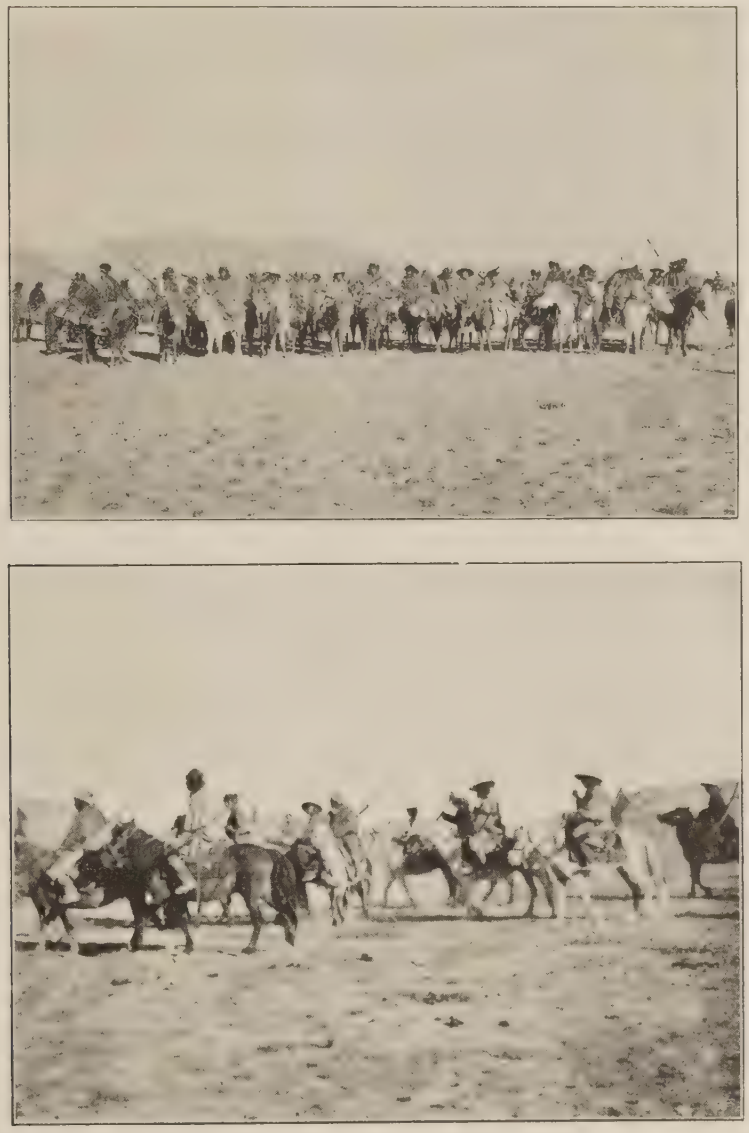


Fig. 32. TIBETAN CAVALRY.

to the deepest basin in the lake. Even yet I did not quite understand the topography of the region. In the south, bearing a couple of degrees to the west, the most outstanding feature in the distance was a dome-topped mountain. In the S. 13° W., where the country appeared to be especially flat, I was led to suppose that

there was a river, either entering the lake or issuing from it, but I had no opportunity of satisfying myself with regard to this. In the S. 39° W. there was a large glen opening upon the lake. In the S. 51° W. a small rounded rocky island rose above the water, and west of the same appeared a large expanse of land which I of course took for an island. Between the two, this expanse of land and the island, runs a sound, and towards it we directed our course. On the south the scene was shut in by a high dominating, snow-capped mountain-range, extending mainly east and west. To the N. 68° W. lay the most northerly promontory of the large insular-looking piece of land; and between the promontory and the N. 53° W. stretched one of the biggest of the lake's large open fjords. From N. 53° W. to N. 46° W.

Fig. 33. TIBETAN CAVALRY.

lay the double island which we had previously seen from the northern shore. To the north-west and north-north-west runs that part of the northern shore along which we travelled in order to reach Camp LXXVIII. Almost every ridge and chain in the region, equally whether forming short, broken, detached masses or hanging together in more continuous ranges, turns a perpendicular or steep face towards the south, whereas the northern slopes are as a rule gentle as well as covered with earth. This is especially true of the chains and ridges which rise on the two islands that we touched at in the course of the day's paddle. The rock, which was close-grained, rather brittle and crisp, and was possibly limestone (*vide* the petrographical section of this work), dipped 47° towards the N. 43° W. The outcrop therefore faced the south-east; consequently the southern side is relatively more exposed to weathering. If this predominant form of relief be considered in connection with a possible former wide extension of the glaciers which would have their source of origin south and south-west of the Naktsong-tso, the natural expectation would be

that the southern slopes of the chains I have spoken of would be gentle and long, and smoothed and filed by the ice-stream, while the northern slopes, as being on the sheltered side, away from the ice-stream, ought to be almost precipitous. This rule holds good, for example, for the region of the primitive rocks that were glaciated in the Scandinavian peninsula. But I hasten to add, that it would be rash to compare the Scandinavian glacial region directly with the Tibetan. The former has been thoroughly investigated, especially by Swedish geologists; it is a particularly favourable field for glacial investigations, because the traces of the icy covering are to be seen everywhere unimpaired and accessible to the light of day. There is no need to travel very far from Stockholm to find the most beautiful examples of glacial striations, moraine ridges, and erratic blocks. The abrasive forces of the atmosphere have not had much effect in levelling down, at any rate they have not succeeded in planing away, the traces of the old ice-covering. But in Tibet the conditions are very different. I have already pointed out above, that the results of my investigation, with the view to discovering evidences of former glaciation, were entirely negative. There do not exist the smallest grounds for believing, that any such glaciation ever extended over the whole of the Tibetan highlands, or that its plateaus were ever buried under a compact ice-sheet of the same character and appearance as that of Greenland. Indeed, if we do allow ourselves to suppose that the glaciers which exist in Tibet at the present day are still diminishing, then we must also restrict our conception of the former glaciation of the country to its highest swellings, that is to say, to the regions in immediate proximity to the crests and peaks which still carry perpetual snow and glaciers. It is for this reason that I say it would be rash to compare Tibet with Scandinavia, and for precisely the same reason the external appearance of the mountains around Naktsong-tso lends no support whatever to the supposition, that an ice-stream once flowed from the mountainous regions south of the lake. Had an ice-stream of the same extent and thickness as that of Scandinavia spread itself out from the south to the north over the interior of Tibet, the Naktsong mountains would have their southern slopes flat, rounded, and smoothed, while they would be steep and rugged on the north, and this altogether independently of the dip of the strata and the strike of the outcrop. But if, on the other hand, we confine ourselves to the supposition of purely local glacial centres, from which glacier-arms more or less considerable proceeded, then there no longer exist grounds for astonishment at the relief forms which the Naktsong-tso mountains now exhibit. These mountains are, it is true, of relatively insignificant altitude: I estimate that the ranges on the northern shore of the lake reach an elevation of 300 m.; the others, both beside the lake and on the islands, are still lower. At any rate they are protected, and would have been in even a yet higher degree protected formerly, against the supposed ice-stream coming from the south-west, for it would only have been able to cover the very lowest mountains, for instance those which now form the small islands beside the northern shore. These are indeed equally rounded on all sides, a fact which led me to compare them to dolphins' backs. But the higher mountains were able to offer effective and unconquerable resistance to the ice-stream. This is in a particular degree true of the most southerly of the parallel ranges which are piled up on the large

island. It was this which received the first and strongest impact of the ice-stream, causing it to divide east and west round that insurmountable obstacle. Consequently its southern side is steeper and wilder than that of any other range in the neighbourhood. Generally it seems to me, that the fact of the southern faces being the steepest may be precisely the effect of the extraordinary force of the ice-erosion which attacked them from the south, whereas the northern slopes lay on the lee side away from the ice-stream, and thus experienced no pressure from it, or at all events a mere trifling pressure. The higher peaks and summits of the ranges thus lifted themselves like islands above the ice-stream, which need not here have been more than a few score meters thick. All the same the absence

Fig. 34. THE LOAF-SHAPED ISLAND.

of all real or unmistakable evidences of glacial action demands that the greatest caution must be exercised in drawing conclusions even from the general features of relief in this lacustrine region. For even though all glacial evidences have been wholly obliterated by the intense weathering and denudation which are now going on, it is fair to infer, that the forms which these mountains now exhibit have to no slight extent been occasioned by the weathering and denudation which have taken place since the glacier-arms receded, and became confined to the exceedingly small areas that they now occupy.

Meanwhile we steered at first diagonally across one of the largest basins into which the lake is divided, and towards the north-western extremity (S. 51° W.) of the little loaf-shaped island. This time the trip was favoured by glorious weather, the lake was almost like a mirror, and it was only now and then that its surface, on which there was a wonderful play of colour, was slightly ruffled. Thus there was nothing to prevent or impede my soundings or measurements of velocity.

Liust. A. B. Lagrelius & Westphal.

HLADJE TSERING AND JUNDUK TSERING, EMISSARIES OF THE AUTHORITIES OF LHASA SENT TO STOP MY ADVANCE.

Moreover I was able to sketch the contours of some of the surrounding mountains, namely those shown on one of the accompanying plates. The following are the soundings I successively took — 2.10, 11.90, 12.70, 11.73, 11.30, 11.36, 12.25, 12.22, and 5.70, the last quite close to the north-western extremity of the island. From the shape of the basin and the contours of the neighbouring mountains I gathered the impression, that it was a relatively shallow part of the Naktsong-tso which we had crossed. To the south of our route was a shallow quarter, while north-west of it the lake-bottom probably sinks down to the greatest depths.

At the point where we landed we found a slab of stone set up on end, crowning a rocky headland that plunges steeply down into the lake. South of that is a little bay, with a flat strip of shore, bearing thick and luxuriant grass, plainly enough at that season inaccessible to the flocks of the nomads. We climbed to the top of the highest point (c. 50 to 60 m.) of the little rocky island where it rises sheer from the water's edge, and found on it three heaps of stones piled up. As the Tibetans possess nothing that in any way resembles a boat, these heaps of stones prove, as do also the large quantities of droppings of yaks, horses, and sheep, that the island is visited in winter, the means of access being the very thick, strong sheet of ice with which the lake is I dare say for five months covered. The island is crescentic in shape, convex towards the south-west, and on almost every side its rocky walls plunge sheer down into the lake. The only living creatures we found on it were pigeons and midges.

From the top of this little rocky island we obtained an especially excellent view all round us; the whole country to the south lay spread out like a map. On that side the boundary of the lake stood out sharply and distinctly. The Naktsong-tso now turned out to be a good deal smaller than I had supposed it to be when I first saw it from the northern shore. From that side the view south had appeared to stretch to infinity; this was due to the refraction of the atmosphere close to the surface of the earth, the whole of the plain on the southern side of the lake being swallowed up in its »liquid» vibrations, the effect being an apparent prolongation of the lake all the way to the foot of the southern mountains. Even whilst we were still paddling on the water this southern range had appeared to rise directly out of the lake. Owing to these optical illusions you can never trust your first impression of these sheets of water. The only way to get a reliable map of their outline is either by riding all round them or by examining them by boat. The little rocky island on the summit of which we stood lies only a couple of kilometers from the southern shore, and the space that intervenes between the lake-shore and the foot of the southern range is occupied by an extensive plain, exceedingly flat, and dotted all over with an enormous number of small lakes, pools, and marshes. This low, marshy ground also makes the shore next the lake very boggy and irregular. The greenness of the surface and the numerous herds of yaks and horses, and flocks of sheep, served to show that the grazing was good. We also counted eight nomad tents and two white cubical houses of stone, possibly small local temples. To the south was a well-marked glen-opening, with a small stream flowing out of it. Under ordinary circumstances one would not have doubted a moment as to the destination of this river; it would of course have been a mountain-stream destined to terminate

in the lake. But, seeing that the Naktsong-tso is perfectly fresh, and that one looks in vain for any sort of beach-line or marks of the lake ever having risen to a higher level, the lake must clearly possess an effluent of some kind. The most natural thing would be for that effluent to run into the Selling-tso, which is not only lower, but lies quite close to the Naktsong-tso. But no such effluent exists, at all events I came across none whilst making my way to Camp LXXIX; nor has Bower, who followed the whole of the southern shore of the Selling-tso, indicated that he found any connection between the two lakes either. There remains therefore the possibility that the Naktsong-tso discharges its waters to the south through a transverse glen that pierces the southern range and empties into some salt lake situated a good deal farther to the south. If that is the case, one would be inclined to suspect that the glen which I have mentioned is that by which the lake discharges. Unfortunately I was not able to solve this problem, not being able to do what I liked owing to the jealous watchfulness of the Tibetans. This question can only be solved by an examination of the country between the Selling-tso and the Kiaring-tso. It is, I admit, improbable that an efferent stream should be sufficiently powerful to force its way through the entire mountain-range which forms the dividing-wall between the latitudinal valley that contains the lakes Selling, Naktsong, and Tschargut, etc. and that in which are situated the Kiaring-tso and several others; but it is possible that there may be a small salt lake immediately south of the Naktsong-tso, and in its basin the surplus waters of the Naktsong-tso will evaporate. There is yet another possibility, namely that the Naktsong-tso may be connected with the Selling-tso by a subterranean stream running north and this is the most probable of all.

The whole of the southern part of the Naktsong-tso is very shallow. The 2-meter curve runs a long way out from land; in fact, the lake-bottom forms on that side the continuation of the flat shore-plain which slopes imperceptibly towards the north. The colour of the water also was there more irregular, and exhibited a greater variety of shades, being dark green — underneath I suspect there were Algæ — yellow, or a light dirty green — there I inferred the presence of sand, mud, and gravel. In the S. 70° E. there is a smaller lake of triangular shape, lying only a score of meters or so from the shore of the Naktsong-tso, and its colour showed that it was very shallow. In the S. 13° E. rose the vast domed, snowy peak which is the dominating feature of the entire region. Westwards our view of this archipelagic scene was cut off by three ridges, modelled in bold relief, and each terminating eastwards in a promontory or projecting rocky headland. The headland of the ridge farthest north screened the northern shore of the island, or rather I ought to say peninsula, for it makes the Naktsong-tso closely resemble in shape the lake of Jamdok-tso south of Lhasa. The southernmost ridge does not, properly speaking, form a headland, but immediately south of it a long, narrow »pier» projects towards the south-east, lifting itself hardly at all above the surface of the water, and terminating in a pointed cape, which was then crowded with flocks of gulls. From the opposite, southern shore a similar cape projects towards the north-west, so that the two between them cause the lake to contract to a relatively narrow sound, the depth in which in its shallowest part did not reach two meters.

Hence a drop of 1 1/2 meters in the level of the lake would unite the island with the mainland by means of an extremely flat tongue of land like that which the next day raised an easily surmountable obstacle in our path. It seemed to me, that generally throughout the whole of the southern part of the lake the depth nowhere reached 3 m.

Leaving the rocky island, we continued southwards to the tips of the »pier», sounding on the way depths of 2.61 and 2.30 m. After that our direction was S. 80° W., with insignificant deviations, until we reached our camp for the night. Immediately west of the pier the depth was 2 m., then 1.46 m. in the shallowest part of the sound, and finally 2.25, 2.10, 2.28, 2.15, 2.24, and 1.67 m. Here the

Fig. 35. SOUTHERN SHORE OF THE BIG ISLAND.

2-meter bathymetrical curve runs at no inconsiderable distance from the northern shore, a thing I did not expect, for the cliffs in that quarter present a perpendicular face towards the south. In fact, they rise like a cyclopean wall, built up of blocks of stone of immense size, with big black eroded fissures gaping in them at intervals. Generally there is a very narrow strip of shore, along which it is possible to advance; but in some places the cliffs plunge sheer down into the water. Nevertheless the lake is everywhere so shallow that you could easily get round them by wading. The bottom consisted of ooze, which came whirling up in black flocculent masses whenever the paddle touched it. The depth along our route amounted, as I have said, to rather more than 2 m., and this depth remained constant the whole way. To the south of our route it was scarcely any deeper, but rather shallower; for one would naturally expect the lowest part of the depression to lie directly under the precipitous mountain-wall and not next to the plain, apparently quite level, that stretches down to the southern shore.

The part of the lake with which I am now dealing forms a clearly marked and separate basin. Its western boundary is, as we shall soon find, very sharply defined, while the eastern boundary coincides with the narrow sound between the two projecting pier-like promontories. At its widest part the basin probably measures 5 km. across, unless this estimate is exaggerated by reason of the atmospheric refraction. Towards the west however the basin rapidly contracts to a breadth of 1 km., and finally is not more than 350 m. across.

Fig. 36. THE SAME.

The wide insular country which we had all the way on our right hand is traversed, as I have said, by three medium-sized ranges, rising to a few hundred meters in height. We have already seen how they terminate eastwards in three headlands jutting out into the lake; the continuation of our trip revealed their western terminations. The first range, the one farthest south, is fairly short, and at its termination a low tongue of sediment juts out from a slight incurving of the shore. A precisely similar, but somewhat narrower, headland projects from the same shore about midway along the southern range. Both promontories point towards the east-north-east, parallel with the shore-line. Thus the former one, that at the sound, bends towards the east. This cannot be due to pure chance, but must be an effect — as the sedimentary capes are in the north Tibetan lakes — of the prevailing wind; which thus appears to come from the west or possibly the south-west, and gives rise to a current along the southern shore of the great island, forcing the solid sediment to deposit itself in the manner described above. Where this sediment comes from was at first inexplicable, for the water of the lake was as bright as crystal, as if it issued out of the purest spring; but it does not require much reflection to trace the source of its origin. Consider first the westernmost of the

three promontories; we see that it lies immediately east of the point where the western half of the latitudinal valley between the southern and the middle range reaches the lake. During the violent rains which fall in this region in the summer there flows down this valley a not inconsiderable stream, formed by the confluence of the numerous small torrents which issue out of the short, steep side-glens that seam the mountain-sides. Vast quantities of fine, powdery, disintegrated material are in this way carried down to the lake, and are mostly swept eastwards by the current along the shore, and this settles gradually against one or other of the pier-like headlands, thus constantly lengthening them. Now let us consider the middle promontory; it is formed principally in the same way, the only difference being that in this case there is no main valley to gather up the torrents from the small side-glens, but each torrent pours its sediment-laden water directly into the lake. There the sediment is caught by the current spoken of above and deposited against the middle headland, which is smaller, and narrow, in consequence of the drainage-area by which it is fed being less extensive. But it is more difficult to explain why the eastern promontory should be the largest, because the drainage-area upon which it draws is the smallest. Possibly the cause is to be sought partly in the configuration of the lake-bottom: that is to say the lake is just in this part rather shallower than it is farther west. At all events it is very unusual to find flat mud peninsulas at the foot of a range that plunges almost vertically down into a lake. The primary condition of their origin is of course the shallowness of the lake. There appeared to be small promontories also along the southern shore.

After passing the third promontory and casting a glance up the latitudinal valley between the middle range and the western range, we continued our trip towards the west, skirting the southern foot of the middle range. The strip of shore was somewhat broader than before, and the grass on it was so excellent and so untouched, that I concluded it was inaccessible to the flocks of the Tibetans, especially as these were now grazing in other parts of the great island. Very likely impassable mountains also cut off access to it from the landside. There were, it is true, animal droppings, proving that that quarter of the island is indeed visited; but they will be left in the winter, when the flocks can easily be driven across the ice from the south.

The middle range, which is in general higher and wilder than the southern range, terminates at its western end in a tapering, perpendicular, and rather large rocky gateway, and below it, on the actual shore-line, rise a couple of small isolated rocky pinnacles. By this the lake had shrunk to a sound only 350 m. broad, and over on its opposite or western side the middle range is continued in another range, which however we only saw foreshortened. Its eastern end forms a great rocky mass, wild and rugged, with steep, bare, fantastic flanks, which plunge down sheer into the lake without the smallest strip of shore at their foot. From that point the southern shore was seen to extend towards the S. 37° E. At the southern foot of the rocky mass was a solitary stone hut, then uninhabited. Somewhat nearer towards the south rises a small detached butte. The wide, marshy plain on the south of the lake appeared to continue a fairly long way towards the west, merging into a latitudinal valley. In this we should, I have no doubt, have found a con-

venient track; for although the ground is at the same time broken, and offsets and spurs jut out from the neighbouring mountains, I dare say there exist easy passes across them. In the S. 25° W. we observed a glen out of which issued a water-course running down into the lake.

Fig. 37. VIEWS FROM THE NARROW PASSAGE IN THE NAKTSONG-TSO.

Camp LXXX was made on the shore of the large island in a very unusual sort of locality, in that there runs out from it into the lake a pier-like promontory, or tongue of land, a hundred meters long, with a mean breadth of 10 m., and lifting itself 1 m. above the surface of the lake. This is formed of the same fine

sedimentary matter as the similar promontories already described; but in contra-distinction to them this is grass-grown and possesses some small pools, which during the night became coated with a thin sheet of ice. The shore, from which the promontory projects, is cut off abruptly and reaches 1 m. in elevation, while

Fig. 38. VIEWS FROM THE NARROW PASSAGE IN THE NAKTSONG-TSO.

on the top it is covered with luxuriant grass. The promontory juts out from the shore at right angles and thus lies athwart the sound, which would be entirely blocked by it, were it not that close in at the foot of the perpendicular cliff on the opposite shore there is a sound of open water, 30 m. across and 1.3 m. deep,

in which we detected a gentle current. It was not easy to account for the presence of this narrow tongue of sedimentary matter, for there seemed to be no reason at all why it should have originated in this sound. Possibly we might look upon it as a continuation, or the termination, of a branch of the third of the ranges on the island, although it does not indeed consist of hard rock, in fact it does not even consist of gravel. But its shape is altogether antagonistic to any such supposition; for its upper surface is perfectly level and its shores abrupt, not sloping gently down towards the lake. Moreover its breadth remains uniform throughout; nor does it exhibit any irregularities such as would suggest a former hilly ridge. The explanation which seemed to me to be the most likely, and on account of the

Fig. 39. VIEW FROM THE NARROW PASSAGE IN THE NAKTSONG-TSO.

relief of the immediate surroundings the most plausible, is this: that we have here at length a trace of a former moraine ridge, that has been left by an ice-stream which once flowed down through this sound. To this question I will however return after describing the rest of the sound. This regularly formed tongue of land does not, it is true, directly resemble an ordinary moraine, but almost seems like the work of human hands; but that may be a pure coincidence. Its summit may have been flattened by aqueous agency at a time when the lake-level stood a meter or a meter and a half higher than it does now. And equally whether the lake is drained by an underground channel or by some river connection that I did not see, it is but natural, and what might be expected, that its level should drop in consequence of the continuous erosion in the efferent channel, the effect being to bring the old moraine ridge above the water and expose it to the light of day. When the water covered it, its surface would be smoothed by the beat of the waves, but except for that the moraine would be protected against disintegration

THE BEGINNING OF THE NARROW PASSAGE OF NAKTSONG-TSO.

Ljustr. A. B. Lagrelius & Westphal.

THE RIVER NEAR CAMP XV, NORTH TIBET.

and the levelling influence of the atmospheric agencies, which have unquestionably destroyed innumerable moraines and other glacial traces that in this region were directly exposed to their effects. I have already pointed out, that this pier-like projection is a formation of quite a different character from those I have mentioned above; and there is no reason why we may not suppose, that several similar moraine ridges are still hidden under the waters of the Naktsong-tso, in which case they will not come to light until the lake has dropped still further. The material of which our pier-like projection is built up does not admit of any sufficiently trustworthy inferences being drawn from it. The circumstances under which I visited this part of Tibet prevented me from instituting a thorough and desirable investigation into this matter. If my theory is correct, one would expect to find that the pier consists in the main of moraine gravel; and it is very probable, that it does for the most part consist of such; but it has subsequently, through the binding and arresting power of the grass, become sheeted with drift-dust, which has gathered there in the dry season. Anyway the only conclusion at which I was able to arrive is, that we really have here an old moraine, modified in a secondary degree by extraneous accidental circumstances.

September 15th. Never have I been more charmed and fascinated by the beauties of a scene and the wild picturesqueness of nature than I was by those which I witnessed in the course of this day. When you are the first to find your way through a watery labyrinth such as that of the Naktsong-tso, and have not the slightest guidance from either map or native, you are kept all the time in a state of expectation. I asked myself again and again, how long this narrow channel was to continue, and whether the land which we had on our right hand really was an island, for if it turned out to be a peninsula, we should have to paddle all the way back again. A little later on we discovered on it two tents, with half a dozen people about them, as well as a troop of horses and a herd of yaks; this seemed to point to its being a peninsula, otherwise these people and their animals could not have reached it from the mainland. We ascertained subsequently, that it really is something intermediate between an island and a peninsula.

It was a still and beautiful morning; at 8 a.m., after a slight frost during the night, the thermometer stod at + 4.1°, while the water at the same time registered 8.2°. In this shallow, sheltered sound it may well be believed, that the winter ice reaches a considerable thickness. The nomads would therefore be able to take short cuts across the lake, and the heaps of stones and »sign-posts» on the little rocky island prove that they actually do so.

On the inside of the pier-like projection, at the root of which we were encamped, is the opening of the narrow passage which we had to follow for hours. On our right we had a short mountain-range, running towards the south-west, and consequently parallel with the sound; in fact, it might well pass for an offshoot of the middle of the three ranges that I have mentioned above. But in this respect there is a great difference between the eastern and western shores of the island. Whereas on the east we had seen only three ranges, terminating in three promontories, on the west we passed no less than eight forks of the mountains, though those to the north were less distinctly separated from one another than those to the south.

Of the three ranges on the island, it was only the two to the south which could be distinctly followed for their entire distance: from the route that we pursued their direction was in the main towards the S. 80° W. But we were not able to identify the westward continuation of the northernmost of the three ranges; to do this satisfactorily would have necessitated our crossing over the island. It is possible that, strictly speaking, this insular orographical system consists in the south of two actual ranges running continuously parallel with one another, but that its northern part forms more properly a mountain knot, from which ramifications and offshoots stretch east and west.

Our long watery highway is divided by projecting headlands into a succession of oblong, elliptical basins, and their depths prove that they actually are independent basins clearly separated from one another. The first of these is however so far different from all the rest that it is entirely embraced within steep, wild cliffs a couple of hundred meters in altitude, though generally there is a narrow, flat, strip of shore at their foot. The mountain-range on the east side of the sound makes a bend towards the west and is then cleft by the sound itself, and just at that point we found the contraction between two basins. Thus that part of the range which lies over on the west side of the sound forms a tolerably detached part of the system and culminates in several small peaks. Both north and south of it broad glens open upon the sound. In the next three basins, going north, it was quite evident that our sound was crossed slantwise by the ramifications of the mountains abutting upon it. The second basin is bordered on the north by two rocky headlands that approach one another. The third basin is demarcated on the north by only *one* promontory, jutting out from the left side. The reason there is no corresponding headland on the right is, that there is there a broad, open valley between two parallel ranges, with a latitudinal valley pass between them. The last basin is the largest of all and is bounded on the north by a broken ridge. South of the western half of this ridge lies a more open valley, similar in appearance to that on the east side. These two valleys may in fact be regarded as mutual continuations one of the other, and together they form one and the same latitudinal valley.

CHAPTER IV.

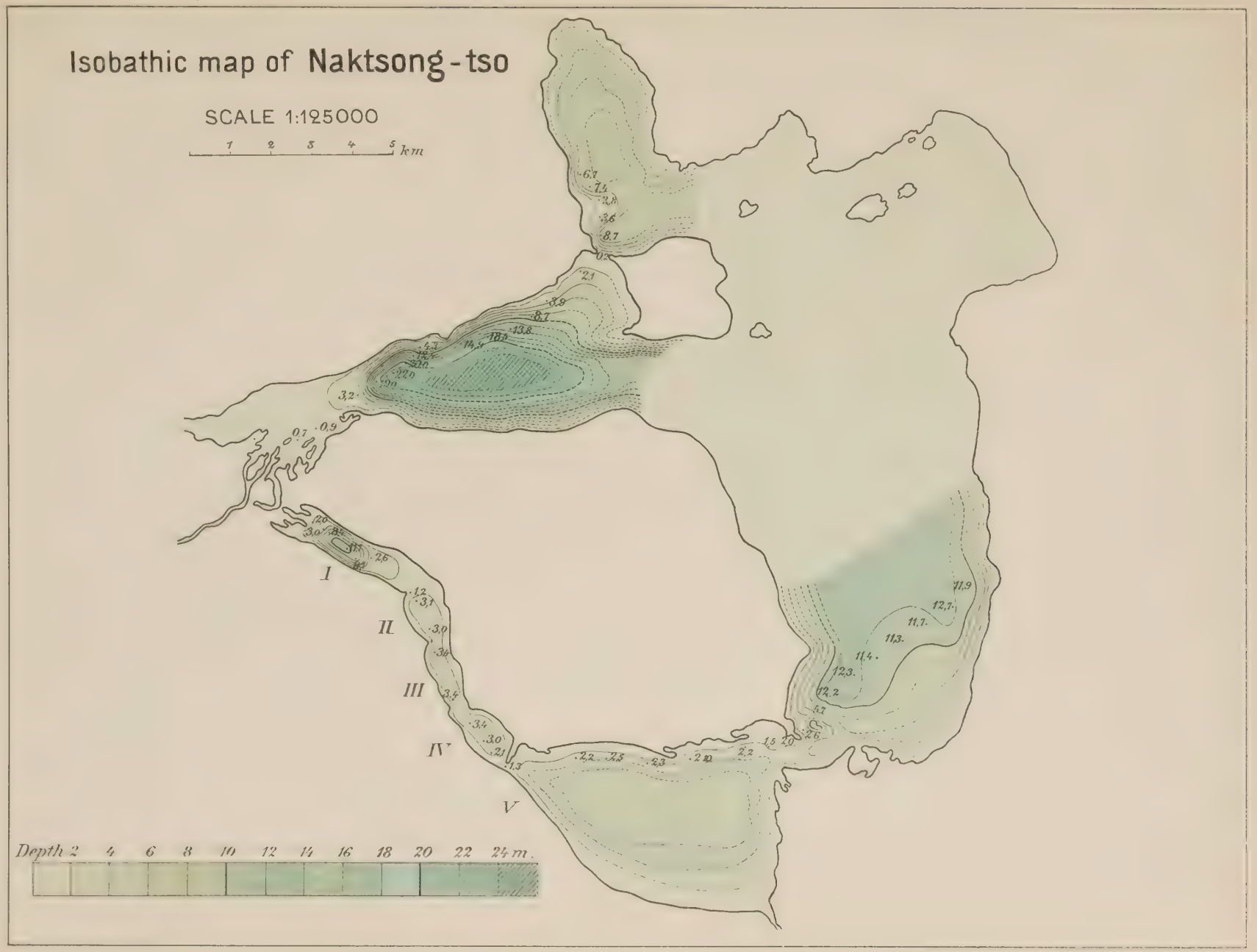
THE NAKTSONG-TSO, ITS SOUND, AND ITS WESTERN HALF.

Broadly speaking this country may be characterized in the following way. A number of mountain-ranges, stretching more or less faithfully east and west and running parallel to one another, rise from what is on the whole a flat region. These ranges are successively pierced by a natural waterway or sound, running from north-west to south-east, and consequently cutting them at right angles, or rather diagonally. From its beginning at the moraine projection to its termination in the north-west this sound is 8.3 km. long, and has a mean breadth of 0.8 km., the maximum being 1.1 km. and the minimum 0.5 km. The ranges on the west side of the sound form the immediate continuations of the ranges on the island; in other words, the sound cleaves its way through these ranges in a succession of gigantic rocky »gateways». At the first promontory on the left, where the hard rock descends directly into the water, the dip of the strata was 37° S., but generally the dip appeared to be towards the north. The rock in question was a close-grained, brittle species, resembling *hälleflinta;* for a detailed description, see the Geological section. So far as I was able to observe in such a hurried trip as this I am describing, the dip of the strata on both sides of the sound was precisely the same, and there was nothing to suggest that any subsidence of the earth's crust, or *Grabenversenkung*, has ever occurred there. A study of *The Great Ice Age*, which I had with me, convinced me, that this formation was almost in every detail identical with the »rock basins» of Scotland, which James Geikie describes in such a masterly way. I had already suspected that the pier-like projection which we encountered at the entrance to the sound is an old moraine; and the farther we advanced up the sound, the more forcibly was the idea borne in upon me, that this elongated trough must have been hollowed out by glacier ice, and that the peculiar, capricious, and fantastic scenery which stretched before us could only have been produced by the erosive action of an ice-stream. My trip was only a preliminary reconnaissance, a pioneer trip; consequently I am not in a position to give any exact arithmetical data, nor do I consider, that I am warranted in speaking with any degree of certainty on the matter. In a later chapter I propose to take a general survey of the lakes of

Tibet; for the present therefore I will confine myself to certain observations which I made in this the most westerly part of the Naktsong-tso. I was not able to discover there, any more than previously, unambiguous, well-preserved traces of glacial action, of the same kind as those in Scotland or Scandinavia. But in respect both of the forms of the scenery and of its general characteristics this sound bears a close and remarkable resemblance to a North European fjord, and upon looking up it, ahead, it was easy to imagine ourselves actually paddling on such a fjord. In each fresh basin the further view was impeded by the next relatively narrow constriction; but after proceeding a couple of kilometers or so, a fresh panorama opened out before us, after the »fjord» had made but a slight inclination to the one side or the other. The garlanded or festoon-like arrangement of the shore, as it sweeps in regular curves from headland to headland, is illustrated in the accompanying little sketch-map. Upon considering the bathymetrical relations in the fjord, we notice first, that these are particularly uniform and similar in the three basins which lie farthest south, where the depth runs about $3.^{1}/_{2}$ m., and nowhere reaches 4 m. The bathymetrical curves for 2 and 3 m., which are shown on the map, are the best proof of the statement, that the sound really is divided into a number of separate basins, and that each such basin is bounded by a more or less projecting promontory. The basin farthest north is the greatest in respect both of length and of breadth, and it is also the deepest.

If now we compare these basins one with another, and number them I, II, III, IV, and V from north-west to south-east, the last designating the last expansion of the lake south-east of the moraine-ridge, we discover a certain uniformity, which renders the existence of former glacial activity in a high degree probable; in fact, it warrants us in assuming that this long narrow fjord-like furrow was hollowed out by an ice-stream, which however has left no other traces of its presence except, first, a couple of hollow grottoes, situated in the southern face of the most northerly range, about fifty meters or so above the existing water-level, and secondly the moraine ridge or pier which I have already mentioned. On the other hand a hole piercing right through the summit of the western range over against our Camp LXXX, as well as a block of stone, measuring about a couple of cubic meters, that lay on the shore of basin No. I, were clearly the results of weathering. But I failed to discover glacial striations here, any more than I discovered them elsewhere in those parts of Tibet that I visited; still their absence does not in any way warrant us, as I have pointed out above, in doubting the former existence of glaciers, because we have to bear in mind the great effects that can be produced by weathering.

Proceeding from north-west to south-east, the first four basins grow successively narrower, and that in a very regular way, while the depth decreases, though less regularly, in the same direction. No. I is three or four times deeper than the other basins. Its maximum amounted to 11.68 m., and the ellipse which represents its 10 meter curve lies in its north-western part. From its deepest point the bottom rises slowly towards the south-east, till it reaches the 2-meter curve in the vicinity of the promontory that bounds the basin on the south-east. From that promontory a subaqueous bank or ridge clearly runs towards the north-east, and on it the depth



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possibly does not reach 2 m., although on my map I have assumed that it does. If we proceed north-west from the deepest point, 11.68 m., we find that the bottom of the basin rises much more steeply. Here however I observed an especially interesting and instructive irregularity in the relief of the bottom, in that a long, narrow ridge juts out at right angles to the north-eastern shore, and consequently runs diagonally across the basin; on this the depth is only 3 m. To the north-west of it the depth is again 5 to 6 m., until the bottom slopes regularly up to the shore. The ridge or threshold in question is thus a formation of precisely the same kind as the moraine ridge at Camp LXXX, the only difference being that the former still lies 3 m. under the surface; and this I suppose was once true of the moraine ridge. This at least is the only way in which I am able to explain its level top, otherwise difficult to account for. Still, notwithstanding the great transparency of the water, it was not easy to determine how far this ridge really is to be regarded as a moraine formation, or whether it is not merely the subaqueous continuation of a mountain-spur; for in point of fact it does occupy the position of the immediate continuation of such a spur. If it really is only the latter, it will of course consist of hard rock, which has possessed sufficient power of resistance to withstand thus far the pressure and friction of the ice. It does not appear to extend all the way across the basin, for on the firm ground on the opposite side there is not the slightest swelling of the surface indicative of a south-western continuation.

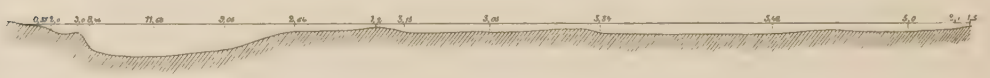
In basin No. II the maximum depth was only 3.15 m., and south-east of that I obtained a sounding of 3.05 m. In this basin also the isobathic curves lie nearer together in the north-west and farther apart in the south-east. From basin No. III basin No. II is separated by a very distinct construction, formed by two blunted headlands. Between these there is also a cross-threshold, which of course has nothing whatever to do with moraine formations, but is simply the subaqueous connection between the two promontories that jut out east and west of the sound, and which, it is quite evident, belonged originally to the same continuous range.

Basin No. III reaches a maximum depth of 3.42 m., and this occurs towards the south-east, though towards the north-west I measured a depth of 3.34 m. This exception to the rule which I have pointed out may however be only apparent, for the line of our skiff's passage did not run symmetrically in relation to the shape of the basin. This basin is a good deal more contracted in width than No. II.

The maximum depth in basin No. IV is precisely the same as in the preceding basin, namely 3.42 m., but it occurs in the extreme north-west of the basin; from that point the bottom ascends gently towards the south-east, for our successive soundings were 3.0, 2.1, and 1.3 m. This basin is the narrowest of all. On the north-west it is bounded by a narrow, shallow passage, to the south-east of the moraine-ridge, which of course forms a far more sharply defined boundary than any in the foregoing basins. South-east of the »pier» the lake swells out into basin No. V, and in proportion as it does so the basin grows broad and flat.

In fig. 40 I reproduce a profile drawn through these basins along the line of our route. The vertical scale is purposely made ten times greater than the true scale. From this it is obvious how the sound shallows towards the south-east. This waterway or chain of basins which I have just described bears indisputably a

great resemblance to the fjords of Northern Europe and the lakes of Scotland. Although we do not possess irrefragable proof of it, I nevertheless venture to believe, that this peculiar passage-way, cut through the mountains, was formed by an ancient glacier arm, which came from the west and flowed towards the south-east. Seen in profile this glacier arm would have tapered away towards its terminal point, as all other glaciers do, and its surface will have drooped exceedingly slowly towards the south-east, but at the same time its bed or floor will have risen even more slowly in the same direction. This latter circumstance would depend upon the well-known fact, that the force of the glacial erosion would decrease with the thickness of the ice, so that the part of its bed in which the ice-stream was most developed, that is basin No. I, became the most deeply hollowed out. In consequence of the progressively greater amount of melting that would take place in the ice-stream as it advanced south-eastwards, it would decrease in thickness in a perfectly regular and uniform way, and this is clearly shown in the shape of the entire fjord. The mountain-mass which plunged vertically, or nearly vertically, down into the water directly opposite to Camp LXXX, seems to betray that for a long time the pressure of the ice-stream against it must have been especially severe. Under these circumstances one would indeed expect to find the sound descend to a considerable depth close in at the foot of the precipice; against this however is to be set the circumstance, that during the time the ice was retreating, the relief of the lake-bottom will have undergone a good many secondary alterations. And the existence of the sharply defined »pier», which I have suggested is the remainder of an old terminal moraine, is a direct proof that changes of that character did take place in exactly this locality. For a relatively long period this formed the end of the glacier, so that it had time not only to fill up any deep pit there may have been at the foot of the precipice, but also to build up a terminal moraine, which we now see projecting above the existing surface of the lake.



NW Basin N:o I N:o II N:o III N:o IV SE

Horizontal scale = 1 : 60,000. Vertical scale = 1 : 2400.

Fig. 40. VERTICAL SECTION OF THE NARROW SOUND OF NAKTSONG-TSO.

For its north-western boundary basin No. I has firm ground, though it is ground which, even when seen at a distance, shows that it is of a very different consistency from that which we had hitherto encountered round this lake. The passage between the mountain walls on both sides is there blocked by fine yellow sediment or mud, resting upon blue clay of a similar soft character; sometimes these formations change places and the blue clay comes to the top. This deposit of sediment is exceedingly flat and level, and rises only the merest shade above the water. Close to the water's edge it was saturated with moisture, and we

sank into it a foot deep; but a little way from the water's edge it was dry and hard, and bore a sprinkling of thin grass. From the shape and consistency of this belt of sedimentary matter, it is hardly possible to err as to the manner of its origination. At the foot of each mountain-wall, both that on the north and that on the south, a long narrow bay runs towards the north-west; while between them comes a third, very much narrower. It was into this last that we drove our skiff. It soon ended at a point, and its upper part was excessively shallow. The bottom consisted entirely of mud and clay. However, it was easy to see that this formation was the deltaic arm of a river, which had laid down vast deposits of sediment, and these send out two long pier-like projections, flush with the surface of the water, and terminating in the south-east in a couple of points that block the mouth of the river. I have already called attention to the extremely peculiar shape of the Naktsong-tso: it resembles a ring of water surrounding a large island placed excentrically in its south-western part. All the way from the moraine-ridge at Camp LXXX we have found the lake to consist of a narrow water-way, slightly increasing in breadth however towards the north-west. But here, in the western part of the lake, immediately north-west of basin No. I, the watery ring is interrupted by a river that enters it from the west and forms a delta reaching right across it. From the route I was following I was only able to observe this deltaic region from the distance, though, had time permitted, it would well have repaid a thorough examination.

My observations as to the distribution of the water and the characteristics of the river amount to this. The little branch of the stream that is inclosed between the mud »piers», the one into which we drove our skiff, terminates, as I have said, in a point, and is thus cut off and dead, being in fact now nothing more than a bay of the lake, which has penetrated into an abandoned eroded bed. In the line of its continuation towards the N. 78° W. we perceived evidences of water. This showed, that this branch had been fed by a far bigger branch, and after a tramp of barely 400 m. across the deltaic mud we reached the right bank of the latter. It was however cut off and isolated from its fellow, although full of very muddy water, with a mean depth of 1 to 2 m. It formed a sharply defined channel, about 10 to 15 m. broad, and was crowded with Algæ and sea-weed. The water was however perfectly motionless: we were unable to detect even the slightest sign of a current. It was indeed at first surprising to find, that the water in a stationary, cut-off branch such as this was muddy; but the cause was I dare say the great number of wild-geese, wild-duck, and gulls that we observed swimming and diving on it, making no end of a quacking and screaming; it is no doubt they that stir up the mud at the bottom, as they hunt about amongst the Algæ.

The mouth by which the river actually discharges at the present time lay some distance west of my route, and reaches the lake by two principal arms, and off them are a number of very low mud-islands and mud-banks. The amount of water in this river was at that time insignificant, only a couple of cubic meters at the most, so far at least as I was able to estimate it at a distance. Now it is perfectly self-evident, that the two detached branches farther east are either definitively cut off and abandoned, or are only used when the river rises exceptionally high.

Launching our skiff again on the branch that I have mentioned, we paddled north, the river winding but little. In its lower part it is joined from the left by a tributary, which likewise issues from the actually existing principal stream, although accidentally cut off from it. At length our deltaic arm widened out and entered the extreme western part of the Naktsong-tso; which part again forms an independent basin, though of no great extent. Along the line by which we crossed it it was very shallow. At first the depth was barely half a meter, and we were surrounded on all sides by long mud-banks and peninsulas and promontories lifting themselves only one or two decimeters above the surface of the water, and all pointing towards the north-east. Beyond them followed a number of islands and islets of a similar character. The circumstance that they were all grass-grown, as was the actual channel, rendered it probable that the eastern river-arm had not been used at all recently; for had it been, the vegetation would not have been able to establish itself, but would repeatedly have been covered with fresh deposits of mud. This however is not true of the first deltaic arm into which we penetrated from basin No. I. It was destitute of plant-life, no vegetation having succeeded in establishing itself there; hence it would appear to have been used at a later date than the deltaic arm that discharges towards the north. Outside the last-named, between the peninsulas and the mud-banks, we were able to trace distinctly a deeper channel, having at first the mean depth stated above, namely $^1/_2$ m., though this subsequently increased to 0.65, 0.91, and 1.00 m. Close to the sides of this deeper channel the stream was so shallow that our light skiff was quite unable to make her way. This channel, which we were able to follow a pretty long way out into the lake, proves however, not only that the now abandoned eastern branch formerly possessed a not inconsiderable erosive power, but that it cannot be very long since it ceased to function, otherwise the lake-bottom outside its mouth would have been levelled up by the beat of the waves, the movement of the current, and the deposition of sediment. Two facts are undoubtedly true, namely that the river is heavily charged with sediment and that the delta is growing. It is not so very long since the peninsula, with the many east-west ranges of mountains on it, really was an island, entirely surrounded on every side by water. That part of the lake which lies immediately west of it was no doubt at first relatively deep, for towards the south we still find a depth of 11.68 m., while farther north it goes down to 19 m. But the intervening section of this part of the lake has on the contrary become increasingly filled up with sediment, which has been carried down and deposited by the river that comes from the west. Originally the river emptied into the lake through its western side; its latitudinal valley still opens out there between two parallel ranges. Gradually a delta grew up, stretching its mud-flats north-east, east, and south-east. This delta then spread out more and more towards the east, gradually contracting the open waterway (the sound), until at last the most easterly, most advanced part of the delta came into contact with the extreme western peninsula of the large island, thus connecting it with the land on the opposite side, and the island consequently ceased to be a true island. Still going on increasing in size, the delta at length, as we have seen, filled up no inconsiderable part of the sound itself. It is however everywhere so flat that the river-arms are extremely sensitive to the slightest changes in the sedimentary deposits.

Ljustr. A. B. Lagrelius & Westphal.

TIBETAN CAVALRY.

When the eastern arms began to flow across a relatively higher part of the delta, the current broke away and shifted its mouth a step farther west. But, as I have already remarked, during the high-water period certain parts of the eastern arms are also probably used as channels of discharge. Thus the water spreads itself by means of the sloping sedimentary delta into those parts of the Naktsong-tso which lie north and south of the delta. To judge from the relief of the lake-bottom, larger masses of sediment have accumulated to the north of the delta than in basin No. I; for a considerable area to the north is so shallow that it cannot be very long before it becomes completely levelled up. In that quarter the one-meter curve runs at such a great distance from the existing shore-line that the intervening area is almost as great as that part of the delta which lies above the water-level. In fact this river, the source and character of which unfortunately I had neither time nor opportunity to investigate, is in a fair way to fill up the entire western part of the lake with sediment. By its valley too — which runs principally, I have no doubt, from west to east — the ice-stream travelled, to which I have in the preceding pages ascribed the origin of the fjord-like sound. In considering the directions in which the glacial streams would flow, we must not of course lose sight of the fact, that there would be local deviations. In this region, if we may draw any inferences from the positions of the mountain-ranges, the ice-streams would appear generally to have come from the south and south-west. If that was so, then the particular ice-stream I am discussing must have been an exception to the rule. Probably in the locality in which we now have the river-delta it divided, that is to say, it sent off a second arm to the north-east; here we discovered also a narrow passage, though it speedily widened out towards the east.

From the deltaic region a bay penetrates towards the west, and is inclosed on both north and south by naked crags, those on the former side being especially imposing. The bay does not however penetrate particularly far inland. At its innermost angle the strip of shore is especially flat.

After issuing from the mouth of the stationary deltaic branch, we paddled towards the north-east, across the very shallow basin of the Naktsong-tso, the depth reaching 1 m. at only one point. As this shallowness is unquestionably caused, as I have already said, by deposited fluvial sediment, it may be pretty safely assumed, that there exists a channel of deeper water along the northern side of the basin and quite close to its shore; and in this surmise I am strengthened by the circumstance that, farther east in the same direction, the one-meter curve runs close to land and the depth rapidly increases as you put out from land. Along this shore too there rises a mountain-range, with a precipitous descent to the south, the range reaching its greatest altitude beside this particular basin of the lake, but sinking towards the east. Directly north of the river-mouth the range is pierced by a steep-sided transverse glen, which terminates at the lake. At the head of that glen, at the distance of about one kilometer from the shore, there is a second range parallel to the first one, and presenting the usual rugged, craggy appearance; like the other ranges in that region it stretches from south-west to north-east. Between the various ranges lie small and unimportant latitudinal valleys, the dry rivulets of which converge upon the transverse glen. This itself possesses a stony and rather steep watercourse,

which bears unmistakable evidences of carrying appreciable quantities of water after rain. On the strength of these orographical relations, and of the soundings which I made *en route*, certain general conclusions may be drawn with regard to the bottom relief of the western basin of the lake. The deeper channel which I have assumed to run quite close to the northern shore ought to be interrupted opposite to the end of the transverse glen by a belt of shallower water, not only because the temporary stream which courses down it ought to deposit the solid material it brings with it, but also because it has immediately south of it the large mud-delta, the flat, gently sloping »scree» of which possibly reaches as far as the northern shore of the lake. West of that shallow belt the deeper channel ought, on the other hand, to continue until it is succeeded by the shallow shore region in the extreme innermost bay on the west.

This basin of the lake, which I have just cursorily described, narrows somewhat towards the north-east, and finally is bounded by a long promontory, little more than 1 m. broad, that juts out from the eastern shore, but slightly above the surface of the lake; it rises, however, a little towards its extremity, though not more than a couple of decimeters. It is built up of sand, and consequently is different from the three promontories that project from the southern shore of the island, for these are formed of mud, and point towards the east or south-east. Nor can this long sandy promontory be regarded as an immediate continuation of the nearest mountain-fork; everything is against that supposition — its consistency, its shape, and its position. If however the view which I have thrown out above is correct, that from the river-valley on the west there issued a glacier-arm, which, splitting against the mountainous upswelling of the island, continued as a double ice-stream, one branch proceeding north-east and the other south-east, it ought not to be considered too bold a supposition to look upon this *circa* 100 meter long pier-like projection as an old terminal moraine, which was formed at a time when the glacier in its westward retreat had reached the position that »the pier» now occupies. Its surface, like that of the »pier» at Camp LXXX, is very level, except for the slight elevation towards its extremity. It must be left to future investigators to solve this problem, and to determine how far my view is right or the reverse. Before continuing the further development of my view, I will finish my description of the »pier» itself.

The surface of this moraine ridge, unlike the surface of that at Camp LXXX, is barren, and it curves like a bow; in fact, it is shaped approximately like a scythe, with its concave side facing south-west, that is to say the mouth of the glen out of which the glacier formerly flowed. In the bay which is thus created on the south of the river-arm the lake-bottom lies, so to speak, flush with the water-level and is formed of soft ooze and decaying vegetable matter, clearly Algæ and seaweed of the same description as those which we found in the cut-off deltaic arm; it is carried thither by the movement of the current along the lake, but gets arrested on the way by the »pier», where it forms a mass of sludge. This promontory may be regarded as the boundary between two very unlike parts of the Naktsong-tso, being situated at the narrowest spot in that section of the lake, while east of it the lake spreads out into one of the largest continuous sheets of water that it possesses.

From the extremity of the »pier» it is only 400 m. to the 3-meter curve, and another 380 m. brings us to the 12-meter curve, and 380 m. more to the 20-meter curve. On our way between the promontory and Camp LXXXI we sounded the following depths — 3.19, 12.60, 19.02, 22.20, 20.03, 12.47, and 4.30 m. These relatively deep parts lie north-east of the promontory, and quite close to it, whereas throughout the whole of the region south-west of it there is only one spot in which the depth is as much as 1 m. This suggests, in the first place, that the »pier» dams back the river sediment and forces it to settle on the south, as well as hinders it, at any rate to a great extent, from filling up the basin to the north; hence the relatively great depth on that side. The positions of the isobathic lines make it conceivable, that the extreme declivities of the sedimentary scree could be traced all the way to the northern shore of the lake. Were a sufficient number of soundings to be taken to the north-west of the »pier» promontory, they would probably prove, that this continues some distance towards the north-west, until it finally becomes merged in the sedimentary scree.

Fig. 41. NORTHERN PART OF NAKTSONG-TSO.

What we did find however in this peculiarly formed western part of the Naktsong-tso is, that both the basins which lie outside of the sedimentary delta exhibit the relatively greatest depths in the lake. In the south the depth amounted to nearly 12 m., but in the north to 22 m. We can scarcely assume however, that the westernmost bay possesses such a considerable depth, because in it one and perhaps several rivers empty themselves. Originally basin No. I was connected with the basin to the north-east of the »pier» promontory, and that part of the sound, which is now filled with the sedimentary delta, will during the glacial period have been quite as deep as the two basins; but since the glacier disappeared it has become filled up with fluvial sediment. For this reason it is doubtful whether the land on

the east should be called an island or a peninsula. And the uncertainty is still further deepened, when it is remembered, that the southern deltaic arm does sometimes carry water still; for at such times that land becomes, at any rate temporarily, entirely surrounded by water on all sides, and only becomes joined to the mainland when the southern deltaic arm ceases to flow. If so disposed, you may equally well call it a peninsula; for it can be reached by a land-route, by merely wading across an insignificant branch of the river.

Accordingly we paddled the rest of the way to Camp LXXXI with mountains on both north and south of us. On the northern shore of the lake stands, as I have said, a mountain-range, which though *per se* unimportant, is nevertheless distinctly outlined, with a steep southern flank, the reason of this being that the rocks dip towards the north or north-west, possibly also the former glacier may have exercised pressure upon the southern base of the mountain-range. The next range on the south rises on the northern side of the big island, and presents a longer and gentler slope of soft earthy strata covered with grass, through which small knobs of hard rock protrude here and there. It is this orographical structure which leads me to think that our route, although running nearer to the northern shore of the lake, nevertheless took us over the greatest depths. From the point where we obtained the sounding 12.06 m. the bay on which stood Camp LXXVIII bore N. 84° E., and the summit L_2 bore N. 87° E., while to the S. 88° E. appeared one of the smaller islands, as well as the peak M_2 on the eastern shore, and the northernmost cape of the big insular land was seen to the S. 69° E.

Meanwhile we paddled on towards the N. 60° E. and at length approached a headland on the northern shore. In the later part of the afternoon we encountered quite a crisp headwind; had it not been for this, I intended to have steered straight across this basin of the lake to the smaller island in the east. Close to the shore behind us, where the sun was touching the horizon, the water was dark green and the lake vegetation stood out clearly and distinctly as if seen through plate-glass; but shortly after the sun set the lake turned a dark blue. The shore on which Camp LXXXI was pitched consisted of gravelly sand and fine gravel, with a thin sprinkling of very thin grass; but a number of stones, arranged in a square, no doubt round a small tent, proved that the spot had been visited by nomads or hunters. At the distance of a couple of meters from the water's edge ran a low and insignificant rampart, formed by the beat of the waves and the pressure of ice; this had nothing whatever to do with any conceivable changes of level in the lake. Also along the face of the hard rock that plunges straight down into the lake at the fjord-like passage, I observed, 1 1/2 dm. above the then water-level, a very distinct mark, which was undoubtedly caused by ice. Yet it is not at all impossible, that the level of the Naktsong-tso does oscillate slightly in consequence of the varying amounts of rainfall at different seasons and the varying supplies of water which the rivers consequently contribute to it.

The last portion of our paddle towards Camp LXXXI enabled me therefore to establish the fact, that the lake is annular in shape, and presents in general a highly peculiar and unusual appearance. It belongs to a type of lake very different from those which we had hitherto encountered. The lakes we came across on the

high plateaus of northern and central Tibet are either round or elliptical, shallow and uniform, with flat shores and almost always without islands. Here in the south however we have a lake that is remarkably peculiar and fantastic in outline. And that it must indeed be so is clear when we compare the dissimilarities which mark the mountains that shut in the round and oblong lakes and those that encircle the Naktsong-tso. The former are very flat and rounded, and consist almost exclusively of soft powdery disintegration products; and in consequence of the low pitch of their slopes it is not possible for bays, headlands, and islands to originate in the former lakes, at all events none worth speaking about. The latter mountains are, on the contrary, sharply accentuated, with steep or almost vertical sides, and are wild and fantastic in outline, and built up almost entirely of hard rock. Consequently the shape of the lake, being directly determined by the setting, must obviously be capricious and picturesque also. The Selling-tso may be regarded as a form intermediate between these two types. In some districts, for instance beside the big northern peninsula and in the bay of the Jagju-rapga, the lake is capricious in outline, elsewhere however it appears to be in general fairly circular. To this problem we shall however return later on. For the present I will only say, that the differences of relief between the relief forms of the northern mountains and those of the southern mountains are of course caused by the more or less advanced denudation and atmospheric levelling; these processes have advanced farther on the great high plateaus than they have in the south of Tibet. In the latter quarter however glaciation has been more extensively developed than in the north, giving rise to more fantastic superficial forms and lingering longer, whereby the southern mountainous regions have been relatively longer protected against the attacks of the atmospheric agencies. And finally, I would remark, that the reason why glaciation covered a wider area in the south than in northern and central Tibet is that the rainfall there was incomparably greater. Accordingly the factor which has been principally instrumental in determining the shapes, not only of the mountains, but also of the lakes, is the rainfall.

On the 16th September, the last day of our boating excursion before rejoining the caravan on the northern shore, the weather was unfavourable, and this upset my plans. At 7 a. m. the temperature of the air dropped to $+4.1°$, while that of the water was $9.6°$. The air turned raw and cold, and the sky became covered with clouds to such an extent that it was as dark as twilight. At first we steered towards the N. 85° E., in order to get round a flat cape, with a pool at its base. After that we inclined more and more towards the north-east, making for a rather large, low-lying island. On our left we still had the same mountain-range as before, while on our right the big island, or rather peninsula, receded farther and farther into the background, and the waterway widened out into one of the largest of the open basins in the lake. The water was of a glorious blue-green tint and transparent to a considerable depth. The weather was typically Tibetan. There was a strong head-wind, and the heavy banks of cloud, which hung directly over our heads, kept up for fully two hours such a bombardment of hail that sometimes the storm actually moderated the violence of the waves. After a while the hail passed over into snow, which came down so thick and fast, that the mountains all round and the big

island were very soon sheeted with white. All this while the sun was shining on the country to the east, and it was there perfect summer weather, whereas we were in the midst of winter. We were paddling towards the north-east; but close to the surface of the earth the wind was blowing from the north-north-east, while the hail and snow clouds were drifting in the opposite direction. Owing to the height of the waves we had to keep pretty close to the shore. Up to a cape on which we landed in order to take a look round, we sounded the following depths, — 14.90, 18.53, 13.03, 8.75, 3.95, and 2.0 m. This line of soundings is very excentric, and is far from being sufficient to warrant any conclusions as to the shape of the lake-bottom. All the same I have on the accompanying sketch-map ventured to prick out the courses of the isobathic curves such as from the relief of the adjacent shores and islands I should suppose them to run. The greatest depth, 18.53, lies off the steepest and most accentuated slope of the mountains, namely a short spur jutting out from the shore-range. Consequently there is every reason to suppose that this range, which is not indeed so steep or craggy as the cliffs that frown down, for example, from the southern side of the big island, descends directly to the maximum depth of the basin, and from that maximum depth the bottom rises slowly and uniformly towards the northern shore of the large island. Nevertheless I have no doubt that there is an even greater depth some distance beyond the line of our soundings, for in the western part of the lake we had obtained a sounding of 22.20 m.

Climbing a hill on the shore, I was able to get a general view over all that part of the lake and also took the bearings of several important points. The western extremity of the low island that we were approaching along the line of the diminishing soundings lay to the N. 70° E., quite close at hand. In the case of this island too it was doubtful how far it really was an island or whether it was not rather a peninsula; on its low, softly rounded hills a troop of horses were grazing. In the S. 81° E. rose the peak L_2 and in the S. 69° E. the mountain-mass M_2, both these being on the east shore of the island. In the S. 57° E. appeared a smaller hilly island and the extreme southerly cape of the medium-sized flat island. Between the S. 54° E. and the S. 33° E. appeared a double island. This part of the lake is richer in islands than one would credit simply from seeing it from the northern and eastern shores, for all the outlines melt together, and the intervals between the islands resemble deep fjords. In the S. 28° E. we saw the eastern extremity of the big island, and in the S. 17° E. the outstanding dome-topped snowy mountain.

Leaving the promontory from which I took these bearings, we steered towards the north-east. The depths which we obtained were 1.98, 2.12, and 1.25 m. The water now assumed a light green colour. On the mainland, at the base of the hills, runs a rampart with grass. The boundary between the lake-basin across which we had been paddling and the basin that lies to the north of it is very sharply drawn, in that a couple of promontories jutting out, one from the mainland and the other from the moderate-sized island, nearly meet, leaving only a comparatively narrow passage between them. There the depth was only 1 to 2 decimeters, and even at the deepest spot our skiff scraped against the bottom. The horses which we saw on the island had evidently been driven across at this shallow ford, against which the waves were breaking in foam under the heavy »sea» that was on. This ridge, though

pierced in the middle, is of great interest; for, like the similar formations which I have already mentioned, it may be regarded as an old terminal moraine, which has been protected against destruction by the water. Wherever it rises above the surface of the lake it is flat and level, and consequently can hardly be regarded as a continuation of the stretches of hills that occur on both sides of it. The material of which the ridge is built up likewise consists of consolidated coarse sand and gravel. This ridge, too, like the promontories of the festoon arrangement in the narrow sound of the Naktsong-tso, may be regarded as indicating a more stationary position of the glacier in the course of its retrogression.

The bathymetrical relations on both sides of this ridge are different: to the south the lake is very shallow; while on the north side it descends by steep steps, so that close to its foot the depth is 1.51 m., but sinks relatively quickly to 8.77 m., this being the deepest sounding that I obtained in the northern basin of the lake. Nevertheless it does not warrant us in drawing any certain conclusions, because it represents the form that might equally well be assumed by a ridge that is the skeleton of a hard-rock range as by a moraine ridge. Immediately south of the ridge the bottom of the lake is bare, but at the northern foot Algæ grow luxuriantly. On both of the approaching promontories there were large flocks of gulls, as on the previous capes.

The last remaining portion of my three days' excursion on the Naktsong-tso was spoiled by the gale and the height of the waves; in fact both were more than my little skiff could face. Consequently I was unable to carry out fully my plan of taking two lines of soundings across the basin to the northern shore, where we were to meet the caravan. Along the one line that we did accomplish towards the north and north-west I obtained soundings of 1.51, 1.86, 8.77, 3.70, 3.52, 2.82, 7.45, 6.78, and 2.45 m. The caravan was waiting for us in the outlet of a flat glen on the western shore; that was Camp LXXXII.

The winter seemed as if it were about to set in in these regions. At 9 p. m. the sky was perfectly clear, but an hour later a gale sprang up from the north-north-east, accompanied with violent hail, and after that it snowed for the greater part of the night. Next morning the ground was everywhere sheeted white, but soon after the sun rose, the snow disappeared, except on the northern faces of the mountains, where, in spite of the sunshine, it remained all day, though it vanished off the southern slopes. The immense range which we saw in the south, and particularly its dome-shaped culminating summit, were quite impressive in their vivid whiteness.

CHAPTER V.

A BOATING TRIP ON THE SELLING-TSO.

September 17th. We now set our faces for home, our next goal being Ladak. We were again to pass the Jagju-rapga, or Dschaga-tsangpo as others called it. In order to avoid treading again in my own footsteps, I resolved to cross the western part of the Selling-tso by boat. I therefore followed the north-west shore of the northern bay or basin of the Naktsong-tso, and then crossed over the narrow and structurally very interesting isthmus between that lake and the Selling-tso. But this day's march was after all only of a preliminary character, a hasty reconnaissance; for dogged as we were at every step by hundreds of Tibetans, it was impossible to work quietly and collectedly. For this reason I had to abstain from taking accurate levellings across the isthmus between the two lakes, and had to content myself with such observations as I was able to make in the course of my ride to the Selling-tso. Yet even those hurried observations were not without profit. Leaving behind us the fresh, limpid water of the relatively deep Naktsong-tso, we rode towards the north, and found it was barely a kilometer to the culminating point of the flat neck of land. The ascent up to that point is remarkably easy and is nowhere diversified by the very slightest indication of an older beach-line. The ground was composed entirely of soft materials — sand and dust — and was overgrown with grass. From that culminating point it is quite easy to see with the naked eye, that there is a real difference between the levels of the two lakes. Upon glancing back, we perceived that we stood only a trifle higher than the surface of the Naktsong-tso, and the prospect across the lake was very little more extensive than it had been from the shore. When, on the other hand, we turned our eyes towards the north, we found that we were able to see an immense distance across the Selling-tso, and that this lake lay at a considerable depth below us, while the distance from the point on which we stood down to the lake-side was four times as great as that which stretched from the shore of the Naktsong-tso up to the summit of the dividing neck of land, that is to say nearly 4 km. I estimated the difference of level between the two lakes at about 40 m., although the hypsometrical observations, calculated afterwards by Dr Ekholm, give the difference as 25 m. only. The northern face of the isthmus bears many indications of higher lake-levels and a wider expansion of the Selling-tso. Our route ran through one

Lmstr. A. B. Lagrelius & Westphal.

TSCHARGUT-TSO, VIEW LOOKING WEST.

of the rocky »gateways» that are so common in that region, that is to say a breach in the range which separates the two lakes. Yet, strange to say, the culminating-point of the isthmus lies at least a hundred meters to the south of the gateway, and we doubled the crags at its western shoulder. These mountains constitute therefore a detached group on the neck of land between the lakes. Towards the east they plunge down perpendicularly in places on the north; and in the face of these cliffs and at their foot we discovered concave excavations or shallow grottoes, 10 to 12 m. high and a couple of meters deep. One of them appeared to be sometimes used as a dwelling-place or temporary shelter, probably by shepherds, for just outside of it somebody had built a low stone wall. The descent from the top of the divide down to this craggy projection was relatively steep, but the rest of the way right down to the shore had a flat and gentle slope, and here I counted six extraordinarily distinct beach-lines in the shape of terraced steps. The highest of these, which runs just under the precipice containing the grottoes, is the most developed, and appears to extend farthest in both directions, following faithfully the northern foot of the range. With regard to the grottoes, there cannot exist a doubt but that they also mark a higher level of the Selling-tso, a level at which the lake remained for a relatively long period, whereas the terraced steps mark successive and relatively rapid subsidences. Nor need it occasion any surprise, that the lake should scoop out such grottoes as these; their existence is easily accounted for by the single fact of the cliff being precipitous, and consequently directly exposed to the wave-beat and ice action of the lake. The rock itself is brittle and weathered, and yields easily to attack. Moreover at the time when the Selling-tso reached up to the foot of the range, the lake spread out to an incomparably greater distance in every direction than it does now, as is pretty evident from the flatness of its shores. When the wind blew from the north the waves would wash a respectable height up the cliff and would have a powerful auxiliary agent in the ice; for it may well be assumed that this lake was formerly even less salt than it is now; the water along its southern shore had a sp. gr. of only 1.0245. When the Selling-tso reached up to the foot of the range, or at any rate to the highest of the six terraces, it would then be at the same level as the existing Naktsong-tso; and, being at that level, it would require but an insignificant rise to give origin to a sound of approximately the same appearance as that the shallow threshold of which we paddled across in the Naktsong-tso. This circumstance contradicts, it will be observed, the supposition which I made above, that the threshold in question is a moraine-ridge. However that may be, there exists nothing which goes to prove that any such connection did exist formerly between the two lakes. The Naktsong-tso has for so long retained its position, that at any rate no older mark remains on its shores. Meanwhile the Selling-tso has dropped step by step, and still continues to fall, so that the difference of level between the two lakes goes on constantly increasing. In view of the imperfect knowledge which we possess with regard to both lakes, I venture to think that the following view is perhaps the most reasonable. The Naktsong-tso is fresh because it has somewhere an outlet; the Selling-tso is salt, because it is the terminal lake, the last recipient in a self-contained drainage-basin. Along the north-west, north, and north-east shores of the Naktsong-tso we found no emissary issuing from

that lake into the Selling-tso, although the latter lies so near and lies a good deal lower. That there is any outflow towards a lake that may exist to the south I consider to be extremely improbable, because there is on that side a formidable swelling in the shape of a mountain-range. Moreover Bower, who was compelled by the Tibetans to turn back when he had reached the south-east corner of the Selling-tso, and who appears to have travelled along the southern shore of the Naktsong-tso, says nothing about any river issuing from the latter and entering a lake on the south. In some respects his statements are as laconic and as difficult to interpret as Marco Polo's, and it is not at all easy to trace his itinerary along the southern shore of the Naktsong-tso; but upon turning to his Diary of the days that he travelled beside the more southerly lake, namely the 5th and 6th October, we read as follows: »An easy march of about 13 miles, crossing a fairly large stream flowing into a lake on the north, to a nomad camp beside some swamps.» Further (on the 6th): »For a couple of miles we went along the bank of a swampy lake; the surface was crowded with duck, geese, and teal; where the water was shallow the *Grus cinerea* was to be seen — — —. The Lama went to the edge of the lake and threw in some valuables, an ancient practice that has at different periods been followed in many countries.»*

Had Bower accompanied his Lama to the lake, and tasted of its water, he would have been able to give us much more valuable information, namely whether the lake was fresh or salt. But the most important thing he tells us is, that the lake which he saw to the north was entered by a fairly large stream coming from the south. On the other hand we are *not* told whether the »lake on the north» of 5th Oct. is identical with the »swampy lake» of 6th Oct. I assume however that both descriptions do refer to the Naktsong-tso, the southern part of which really is very shallow; besides, the occurrence of waterfowl points to the fact of the water being fresh. And when we bear in mind the existence of the mountainous country to the south of the Naktsong-tso, it is scarcely possible, as I have said, that there can be any salt lake between that lake and the mountains. In a word, everything points to the conclusion, that the Naktsong-tso does not discharge to the south either. This lake is therefore a freshwater lake, which receives almost the whole of its supply of water from the mountains to the south of it, but receives practically none from the north, or east, or west, with the exception of small transient streams after rain. Since however there exists no visible emissary, the lake must possess a subterranean outflow; otherwise it would not be able to maintain itself at the constant level which its shores show that it does maintain. Whether the inflow be copious or whether it be scanty, the surplus water runs away upon reaching a certain level, and nothing is more probable than that this surplus water makes its way into the adjacent Selling-tso. By this means the level of the Naktsong-tso is regulated and moderated, and kept practically constant; whereas the Selling-tso, on the other hand, is dropping, because, being situated in the very lowest part of the whole basin, it fails to possess any regulating factor. Possibly it was a consequence of the infiltra-

* *Diary of a Journey across Tibet*, p. 102.

tion of the fresh water by subterranean means that the sp. gr. of the water in the south of the Selling-tso was not higher than 1.0245.

From the fourth beach-terrace upwards, the slope was scored with a small freshwater rivulet, then however dry. This derives its water chiefly from rain; but it is also possible, that in its upper part springs gush out at the season when the Naktsong-tso is receiving its supplies from the south, and that this is consequently one of the points where the otherwise subterranean surplus water makes its appearance at the surface. To the eye the ground below the lowest (sixth) terrace is perfectly level, and consists of fine mud, which, next the water's edge, was so saturated with moisture, and so soft, that we had great difficulty in getting our skiff launched. We then found ourselves in a bay, inclosed between excessively level sedimentary deposits, low and barren, and lying almost flush with the water, these being the parts of the lake-bottom which were the last to be exposed. The bay is shallow: the soundings taken in it were as follows = 0.9, 2.25, 2.67, and 2.04 m., this last being taken at its entrance, where the bay contracts somewhat. From that spot I noted the extreme northerly cape of the southern shore bearing N. 67° E.; it was in that direction that the lake appeared to extend farthest, indeed it attains quite noteworthy dimensions. The mountainous country on the east was hardly distinguishable, appearing only as a faint yellowish red mist. But the little steep range on the blunted peninsula of the northern shore, with its loaf-shaped rocky summits, was nearer and distinctly visible, as also were the mountains south of the Iagju-rapga, which lie along precisely the same line as the range last mentioned.

The lake-bottom consists of grey-blue clay; and the water had a light-green tint, being very muddy in the bay, but clearer outside. Nevertheless we were unable to see the bottom, partly because of its confusing colour and also because of the absence of Algæ or other objects to break the uniformity. Farther east the southern shore of the lake appeared to consist of a flat, barren sedimentary plain, which stretches right away to the mountainous mass G2, this being an advanced portion of the range between the two lakes; indeed it appeared, so far as could be judged from the distance, to advance all the way to the shore, and to terminate abruptly in the lake. On our left we had a similar sedimentary plain, extremely flat and level, and barren, with an occasional minor promontory and litoral lagoon. This, owing to its shape, compelled us to steer first north and afterwards west. There was a gentle breeze from the east-south-east, and during the greater part of the day the weather was so far peculiar in that, while it was warm and sunny on the lake, heavy clouds hung over the country to the west and time after time discharged their contents earthwards. The caravan, whilst marching along that side of the lake, encountered several showers of hail. The lake was lifeless and monotonous, there being nothing to break the uniformity except long, white strips of foam and gulls hopping about on the promontories. After we had got outside the bay the water became perfectly clear. As far as the promontory at which we turned north-west I took the following soundings — 2.98, 3.15, 2.89, 3.12, 3.22, 3,08, 1.63, 0.62 m., this last close to the promontory, and for a long way outside the bay the lake is shallow. Along the stretch to the next mud promontory the following two soundings were taken — 2.98 and 7.20 m., and after that the water became shallow.

A couple of kilometers to the north of this second promontory is the low, flat, white island, which we had previously seen from the northern shore. Between the promontory and this island the lake is probably shallow, and the two together form a pretty sharp boundary between the western basin of the Selling-tso and the main body of the lake. Immediately west of the promontory is the mouth of the Alan-tsangpo, then quite insignificant in appearance, so that its water exercised no visible influence upon the lake water, for even opposite to the river-mouth the latter remained as clear as heretofore.

Hence we bent our faces towards the west, making for the eastern cape of the range which runs south of the Jagju-rapga. Along this stretch I obtained the following soundings — 3.57, 5.02, 7.80, 6.60, 5.10, 5.02, and 2.51 m., this last quite close to the cape, where the mountain-slopes descend abruptly into the water. South of this rocky cape there is a bay, not penetrating very deeply inland. The southern flank of the mountains is very much steeper than the northern flank. Continuing our trip towards the west-north-west, quite close to the foot of the range, we obtained soundings of 7.38, 6.60, 5.55, 2.88, 2.42, and 1.65 m. Camp LXXXIII was pitched in the vicinity of Camp LXXVI, but on the left bank of the river, not far from its mouth.

Regarded even as a reconnaissance, this little trip across the Selling-tso was of course far too incomplete to convey any idea of the character of the lake-bottom. The impression which I derived from different parts of the Selling-tso was that the lake is on the whole very shallow. Its position in the midst of an unusually extensive and flat self-contained basin, into which disintegration products have for a long period been accumulating, and laid down, lend support to my inference. It would however be both profitable and interesting to carry through an accurate sounding of this one of the largest salt lakes in Tibet. But for that purpose it would be necessary to have a reliable boat; such a large sheet of water in such a stormy country as that is not to be traversed without danger. If this lake becomes entirely frozen over during the winter, as I am inclined to think it does, because of its relatively slight degree of salinity and its inconsiderable depth, a sounding expedition would be attended with far less difficulty if undertaken at that season. The western bay, which is relatively sheltered, and into which the Jagju-rapga pours all the year round a large quantity of fresh water, may pretty safely be assumed to be frozen hard, for there will always be an appreciable layer of fresh water swimming upon the salt water.* Grenard tells us, that the northern part of the lake was frozen when he travelled along it on that shore (see below). With regard to the shape of the lake, we are now in a position to draw its outline, at all events roughly. I have myself mapped the greater part of the northern and the whole of the western shore, as well as a small part of the southern; while Bower has traversed the rest of the southern shore and Littledale the eastern. Both English travellers kept however at too great a distance from the water's edge to

* In this western bay and a good long way out into the lake there were immense quantities of a small Crustacean, which Prof. W. Leche identifies with the species which G. O. Sars has named and described as *Daphniopsis Tibetana* (*vide* vol. VI, Part I, p. 67). In some places the lake waters even at a distance, assumed a deeper tint owing to the presence of these animalculæ.

have plotted it with anything like accuracy; but one thing their itineraries do settle for us, namely the limits to which the lake extends in the directions indicated. The knowledge which we previously possessed of the Selling-tso and the Naktsong-tso was not great; but I conceive that I ought to do the above-mentioned travellers, both of whom visited the region before me, the justice to quote their observations. To Grenard, whose observations are the most important, I shall have to return later on. Captain Bower describes the two marches he made to his camps 50 and 51 (6th and 7th September 1891) in the following terms:

»A few miles after leaving camp 49 we crossed a narrow neck of land between two lakes, the northern one of immense size, while the southern one was of extremely irregular shape, having branches running up valleys in every direction, and islands, some of them fairly large, scattered about its surface. It was of singular beauty, to the south a high cone-shaped peak, capped with snow, threw its shadow across; but what made the great difference between it and other Tibetan lakes was the freshness of the water. Grass grows right down to the edge, and the invariable adjuncts of fresh water, gulls, and terns, wheeling about and uttering cries, gave a feeling of life and animation contrasting strongly with the death-like solitude hanging over the salt lakes» — — — — »After leaving our last camp we crossed a narrow neck of land, about the size of and somewhat resembling a railway embankment, with a lake on each side. A Tibetan, in the course of conversation with one of the caravan drivers, stated that the large lake on the north, of which we were continually getting glimpses and occasionally extended views, was called Tengri Nor by Mongols and Tengri Cho by Tibetans, but I fear he lied. However, whatever the right name might be, there was no doubt of its being a noble sheet of water, stretching out east and west to an enormous distance, it seemed more worthy to be called an inland sea than a lake. But, like all the Tibetan lakes, it showed signs of once having been larger than it is now; indeed some of the lakes appear to have dwindled to about half their original size. Between it and our camp were some large lagoons of fresh water fed by streams coming down from the hills.»*

As will be seen, this account agrees excellently with the description of the two lakes which I have given above. To call the Selling-tso »an inland sea» is however an exaggeration; what no doubt led Bower to use these words was the fact, that this lake was larger than any that he had hitherto seen in Tibet. When on his return he travelled along the southern shore of the Naktsong-tso, he had no idea that the lake which then lay »to the north» of him was identically the same as that which he had formerly observed farther south, and which was af »extremely irregular shape». But his erroneous conception admits of ready explanation and is quite excusable, because when you stand on the northern shore the southern basin of the lake is entirely hidden behind the large island, and unless you row through the watery labyrinth, as I did, you are never likely to obtain a clear idea of the mutual relations of the several lake-basins. Bower complains, and with justice, of the difficulty of ascertaining the real names of the geographical features in Tibet;

* Capt. Hamilton Bower, *Diary of a Journey across Tibet*, pp. 82 and 83.

with regard to this he makes the following general remarks: »It is almost impossible to get the correct names of places or lakes in Tibet, as every Tibetan lies on every occasion on which he does not see a good valid reason for telling the truth. Sometimes I have asked half a dozen men separately the name of a lake and received half a dozen different answers. The names I have put on my map are those in favour of which slighty more evidence was forthcoming than for others; but still some of them, including those of these lakes, may turn out to be erroneous when further explorations have made us better acquainted with the country.»*

With regard to the name of the Selling-tso in particular, I find the following statement in Bower: »A Lama came to visit us, and was very strong in information regarding the names of places and other geographical facts, but the names and the facts differed very considerably from those given by other people. On the whole I was inclined to think him fairly truthful. He called the big lake in front Garing Cho, the district we were in Naksung Sittok, and to the east lay Doba, Namru Sera, and Nakchu.»*

For the Selling-tso we find on Bower's map the two names Naksung Satu and Garing Cho, but for the Naktsong-tso there is no name. The name Naksung Satu is clearly identical with the name which was given to me, namely Naktsong-tso.

Littledale gives the following particulars about his discoveries in the neighbourhood of Selling-tso. »We passed along the east side of the lake called by Captain Bower Garing Cho, into which runs a river, which we were unable to ford. We could not go further east, because the plain was alive with herds of yak and sheep, and we should have been discovered; so we constructed a sort of boat [for crossing the Satschu-tsangpo], using our camp-beds to make a framework, which we covered with the waterproof ground-sheet of our tent. It answered capitally, and with a rope from side to side we ferried ourselves and all our stores over dry . . . . Seen from a distance, the shores of the Pongok Tso appeared to be piled up with ice-floes, but on getting closer we found the white appearance was due to salt. The grazing in this district was of the most luxurious description, and our animals were now in capital condition.» The name of Selling-tso is to be found in Littledale only in the following connection: »For the greater portion of the way from Zilling Tso to Ladak, our route lay to the south of that taken by Nain Singh, Captain Bower's, of course, being north of that again.»*

On his map we find the name Zilling Tso, and below it in parenthesis Garing Tso.

* Op. cit., p. 82.
* Op. cit., p. 87.
* *Geog. Journal*, May 1896, pp. 466 and 474.

WESTWARDS TO LADAK

Lichtdr. A. B. Lagrelius & Westphal.

ON THE EASTERN SHORE OF TSCHARGUT-TSO.

CHAPTER VI.

BOATING EXCURSIONS ON THE TSCHARGUT-TSO — THE JAGJU-RAPGA.

On the 18th September we left the mouth of the Jagju-rapga and travelled up the magnificent and picturesque glen down which the river flows. According to our Tibetan escort, we should have found a far easier and shorter road had we kept farther to the north, and travelled by a glen the entrance to which we perceived to the north-west. But I was curious not only to find out where the river came from, but also to avoid coming into contact with Dutreuil de Rhins's route; accordingly we kept to its northern, that is its left, bank and proceeded west-south-west. At first we moved at some distance from the river, across a gently inclined plain, with a sprinkling of thin grass on it. We soon reached the eastern extremity of a not very big, but rather steep and fantastic, range, and then afterwards had this range immediately on our right. From the very extremity of the range a swelling proceeds towards the south-east, and it was at the eastern foot of this swelling that we found the seven old marginal terraces that I have already described. The river is not particularly winding, and along this section of its course it is free from waterfalls, the stream being very uniform in width. In an expansion of its glen the Jagju-rapga swells out into a little lake, which, to judge from its numerous sedimentary islands, must be shallow. One would hardly expect to find alluvial deposits such as these, for the river, when it enters the lake-like expansion, is as bright as crystal; but I have no doubt that after heavy rains considerable quantities of solid material are washed down from the mountains, and so find their way into the river, and eventually settle in the lake-like expansion. At its exit from the little lake the river makes a couple of sharp, deep-cut turns and in them its erosive power is considerable. This circumstance cooperates with the deposition of sediment to fill up the basin. On the northern shore of the lake, and at several meters above its surface, we observed a couple of distinct terraces, manifestly of fluviatile origin.

The slope of the mountain-range which runs south of the river is far less steep than that of the opposite range on the north; the cause of this is mainly the dip of the strata, which in the former is to the north-west. On the southern side

of the same range we perceived the summits of a couple of other ranges, likewise of no great elevation. It is from them and the glens south of them that the Alan-tsangpo derives its water. Between the Jagju-rapga and the nearest range on the south there rise a couple of smaller detached mountain-groups, likewise stretching east and west. Generally the valley of the Jagju-rapga may be described as narrow rather than as broad, and the slope down towards its middle from each of the bordering ranges is relatively steep. This again makes the river-bed rather deep and narrow; and the only exception to this is the country adjacent to the lake-like expansion; and that it would not be inappropriate to describe as a tolerably level, grass-grown plain. There the kulans were grazing, and at the foot of the mountains

Fig. 42. IN THE VALLEY OF THE JAGJU-RAPGA.

there were partridges. The southern range is gapped by small, indeed insignificant, side-glens, whereas in the northern range there are none at all, but it forms an unbroken wall of rock, scored with fissures and very steeply pitched rivulets. Alongside the river there occurred not seldom narrow strips of grass of first-rate quality, and on them we saw occasionally marks of nomad encampments. In one place at the foot of the northern range there was a wall. The foot of that same range is all along flanked by rounded screes of gravel, often very stony on the surface, but sometimes also covered with earth and clothed with vegetation.

From one of these screes we at length caught sight of a new lake in the west, which in point of outline appeared to be just as fantastic and peculiar as the Naktsong-tso, to contain an abundance of rocky peninsulas and islands, and to possess rocky shores. The range which we had hitherto had immediately on our right runs out into the lake in the form of one of these craggy peninsulas, its bare rocky walls plunging straight down into the lake, thus giving rise to an especially beautiful

and picturesque scene. Consequently we found it impossible to get round the range at the bottom; but towards its western end we found two passes leading across it. One of these was however considered impracticable for camels, and the other was quite difficult enough. In order to reach it, we had to ride up a very steep acclivity, thickly strewn with disintegration gravel and dotted with projecting points of rock, and having a yawning precipice on the right; but after a while the ascent grew less steep. The altitude of the pass was 4698 m., or 81 m. above the level of the Tschargut-tso, whose altitude is 4617 m.*

Fig. 43. FIRST SIGHT OF TSCHARGUT-TSO.

The summit of the pass afforded a magnificent view. From the southern slopes of the range I had already obtained an excellent general view of the blunt-ended bay of the Tschargut-tso on the south of the rocky peninsula just mentioned; it is from that bay that the Jagju-rapga originates. The water here is drawn into its broad mouth, but soon contracts to the normal breadth of the stream. On the southern side of the bay there is a small detached range. Towards the north-west the view was even more magnificent, and after we had descended a little, past some intervening shoulders of the mountains, we had the whole of the Tschargut-tso spread out before us, its fjords or separate basins stretching away one behind the other to an immense distance westward; and out of this singular sheet of water, difficult enough to understand, there emerged a couple of rocky islands, while on both sides of them were similar dolphin-backed masses of rock, but whether islands or peninsulas it was hard to make out. The whole of this enchanting scene was bathed in bright sunshine, the air was limpid, the water of the lake was a beautiful dark blue

* Through an error it is given as 4607 in the Meteorological Part; the correct altitude is 4617 m.

and as pure as crystal, and everywhere the colour tinting was pure and attractive to the eye.

From the pass, on which the rocks dipped 45° towards the N. 47° W., the surface slopes more gently and consists of soft earth. Down this declivity we marched towards the north-west, until we at length halted at Camp LXXXIV, close to the shore of another bay, contained between the rocky peninsula which I have already mentioned and another similar one on the north. Its shore-line describes a regular semicircle, and the actual strand was strewn with coarse sand, as well as backed by a strand-rampart, 2 m. high, of the same material, which owes its existence to the beat of the waves and the action of ice. This is in fact the side of the lake that

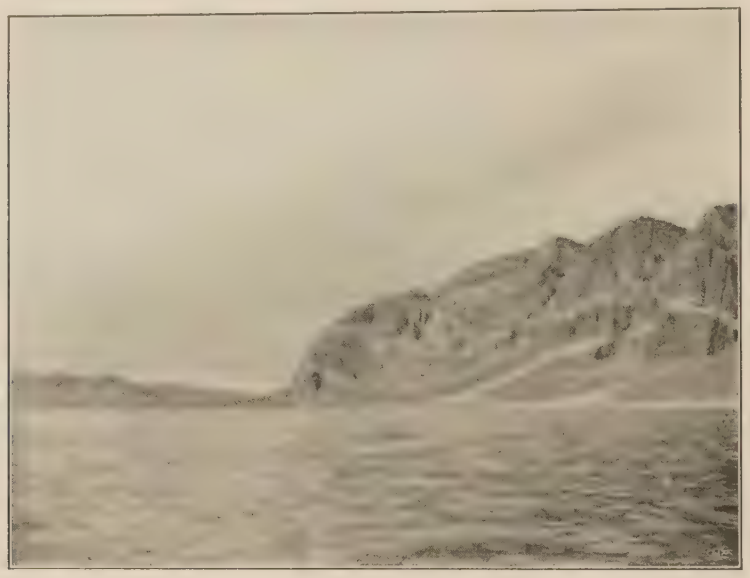


Fig. 44. THE TSCHARGUT-TSO.

is directly exposed to the very violent westerly gales which prevail in that region. In places we observed flocks of wild-duck. The grazing was moderate. With regard to the name of this lake, different informants told me that it is called the Tschaggu-tso, the Tschargun-tso, and the Tschargut-tso. The last-named agrees with Bower's Chargat Cho, with Grenard's Tschargard Tso, and in a still higher degree with Nain Singh's Chargut Cho; hence I have preferred to retain this form in the mean-time, especially as Bower's and Grenard's name is attached to the wrong lake. Nain Singh's Chargut Cho is very fantastic and greatly exaggerated in outline; but, then, that is easily explicable, for he travelled some distance south of the lake.

I spent the next few days in making a preliminary examination of the Tschargut-tso. On 20th September I made two short boating-trips from Camp LXXXIV as my base of operations. The first was towards the S. 73° W., that is to the extreme point of the rocky peninsula already spoken of. Along that stretch I obtained soundings of 8.66, 9.10, and 3.2 m. The cliffs of the peninsula descend

fairly steeply on the north, though nothing like so steeply as on the south side; at their foot lies a scree of gravel and smaller fragments of stone, with a little grass springing up amongst them in places. I had intended to continue the trip across the southern parts of the lake; but my intention was frustrated by a veritable hurricane that came from the west. Its onset was indeed a sublime spectacle. Far away in the west the sky was hung with heavy blue-black clouds, which came driving in swift career across the lake, and in a very short space of time whipped up its surface into foam-tipped waves. Thus I had direct ocular demonstration

Fig. 45. ON THE EASTERN SHORE OF TSCHARGUT-TSO, LOOKING EAST. TIBETAN SOLDIERS.

of the fact, that the waves on the Tibetan lakes can run pretty high; it is fair to suppose therefore that they do exert an appreciable effect upon the shores. And this is especially true of a lake like the Tschargut-tso, stretching as it does east and west in one of the characteristic Tibetan latitudinal valleys, so that it is in a high degree exposed to the wind, which sweeps across it unchecked as though pouring through a gigantic natural funnel. And in view of certain interesting phenomena which I subsequently observed in the lakes situated farther west, I will here call attention to the fact, which is indeed quite natural, that it is the eastern shores of these lakes which are most exposed to the beat of the waves, and it is on them that the strand-ramparts are formed. We shall find as we proceed, that it is precisely those more exposed shores that possess the best developed and best preserved strand-ramparts.

My second trip was towards the north-west, again diagonally across the lake to the extreme point of the blunted rocky promontory which forms the northern boundary of the bay. It belongs to a rather small, free-standing ridge, itself the continuation of a range situated farther to the east. Along this stretch the depth was 6.50 and 7.85 m. After that we crossed the northern bay of the lake towards the west, making for a rocky headland which may be regarded as the westward continuation of the former, and itself forms the extreme eastern end of another range. Generally the shores of the Tschargut-tso are characterised, in respect of their orographical structure, by a great regularity, in that all these moderate-sized ranges stretch from east to west, and, as the map shows, this parallelism is stamped upon the entire basin. The two promontories last mentioned make a natural boundary to the northern bay and round its northern end sweeps a flat, grassy plain. This again is bordered on the north by one of the usual ranges, pierced by a transverse glen, through which a dry watercourse makes its way down to the lake. Through the gap thus made we beheld yet another range beyond, and somewhat higher than the first one. The eastern side of the bay is inclosed by two other small ranges or spurs, exhibiting reddish tints. The shores of the bay present the same regularly curved lines as the bay at Camp LXXXIV. Between the two headlands I obtained the following soundings — 21.40, 24.42, 22.65, and 4.25 m. The more distant headland consisted of coarse red conglomerate, dipping towards the north-west. From that headland we next paddled across to the first rocky island in the south, lying in about the middle of that part of the lake and reaching apparently an altitude of 60 to 70 m. On the way we sounded depths of 27.60, 29.30, 13.90, and 1.00 m. On the north the island was footed by a relatively flat strip of good grass, and bore signs of being visited in winter; for that is the only season when it can be reached, namely across the ice. From this part of the island a cape projects towards the north-east. From an eminence we saw, close at hand on the west-south-west, a rather long pier-like promontory, jutting out south-eastwards from the northern side of the island and possessing a lagoon. Between it and the next mainland promontory on the east there is yet another of the semicircular bays that are so characteristic of the Tschargut-tso, though in this case there was no strip of flat shore. The conglomerate range which rises on its northern side descends pretty steeply towards the lake. South of it is a very short, detached range, and it is from its eastern end that the pier-like headland just mentioned projects. Finally we returned across the eastern fjord of the lake, and in it sounded the following depths — 36.05, 36.25, and 19.20 m. Thus this little preliminary trip sufficed to show, that the Tschargut-tso possesses depths that may really be called considerable, when we remember that they were sounded in one of these shallow Tibetan lakes.

Fig. 46. THE SAME.

Nevertheless, none of these last sounding-lines touched the deepest parts of the eastern basin of the lake, as we ascertained next day when we took another trip towards the southern part of the island along a somewhat more westerly course.

On the 21st September I intended to paddle right across the Tschargut-tso, while the caravan travelled along its northern shore, on the far side of the nearest ranges, the arrangement being that we should meet again somewhere at the west end of the lake. Taking with me a boatman and provisions for three days, and setting out from Camp LXXXIV, I steered first towards the west-south-west and then towards the west, making for the first of the rocky islands, the one which we had already touched on the north. But as usual the wind rose and spoiled my

Fig. 47. TIBETAN SOLDIER.

plans, or at all events prevented me from carrying them out. We had hardly passed the southern promontory of the bay when the gale came, and within a short time the lake was in such a state of violent commotion that it was as much as we could do to keep our boat afloat, without thinking of bathymetrical work. It was not until we had advanced so far as to get a certain amount of shelter from the island that I was able to resume my soundings; and then I got depths of 41.90, 34.10, and 11.75 m. After we had succeeded by incredible exertions in reaching the eastern shore of the island, we had nothing else to do except to lie still and wait for better weather. The waves were beating with uncontrolled fury against the western face of the island, thundering with a continuous roar, and eating away at the shore-line with great energy. The island consists of two swellings; the northern is the more rounded of the two, whereas the other on the south consists entirely of rocky crags, piled up till they make a dominant peak. Scattered about its foot lie a great number of blocks of stone, which have rolled down from above, and now form

savage-looking screes. The dip of the strata was 48° towards the N. 60° E. On the south and west the rocks go down precipitously into the lake, and there the colour of the water alone was enough to betray that the depth was great. Below the northern swelling, which rises less steeply, the shores are also not so abrupt. The two swellings are separated by a relatively low saddle-like hollow, the highest part of which lies 90 m. from the eastern shore and 210 m. from the western. On the latter slope there are 8 distinct, low terraces or ramparts, parallel with the existing beach-line, but on the eastern slope there is only one, setting aside the inconsiderable rampart, formed of sand and gravel, which has been built up by the waves and the ice-pressure during the period of the existing level. The highest point

Fig. 48. SOME OF OUR HORSES.

in the saddle-like depression can hardly have been more than *circa* 15 m. above the level of the lake. Curiously enough, the only place at which I detected any signs that this lake, although its water is fresh, is in process of contraction, was on this island. With regard to the cause of this I will throw out a suggestion in another connection. It is, I dare say, merely a coincidence, that I failed to observe any old strand-lines elsewhere. The eastern shore, on which we pitched Camp LXXXIV, was much too flat and too gently inclined to admit of formations of that character ever coming into existence; moreover even if there had been any there, they would be more exposed to obliteration by the sediment brought down off the mountains. As for the numerous bays to north and south, I never got any nearer to them. They may possibly possess strand-ramparts; but if so, they will be far less distinct, because these bays are more sheltered from the violence of the billowy waves. And of this we were ourselves witnesses; for the dark-green expanse of the open lake was furrowed by the foam-tipped crests of the on-rolling billows, which dashed into white breakers against every cape and headland, but inside the bays the movement of the water was comparatively slight. The island, on which we then were, is

Isobathic map of Tschargut-tso

SCALE 1:100000

1 2 3 4 5 km

Depth 5 10 15 20 25 30 35 40 45 m.

Fotolit. Gen. Stab. Lit. Anst. Stockh.

consequently in a far higher degree exposed to the violence of the storms, for the great bulk of the lake lay to the west of it. And as we subsequently discovered, what indeed the meteorological journal abundantly shows, the wind that prevails with inconceivable regularity all the autumn and winter comes from the west.

Fig. 49. OUR CAMP ON THE BIG ISLAND.

From Camp LXXXV on the island I took the bearings of the capes on the east shore of the lake — N. 36° E., N. 60° E., S. 84° E., and S. 60° E. The point at which the Jagju-rapga issues from the Tschargut-tso lay S. 67° E., and in the S. 36° E a little pier-shaped promontory jutted out from the southern shore. From the same point of observation it was 800 m. to the culminating-point of the northern swelling in the N. 37° W. and 400 m. S. 20° E. to the south-east extremity of the island, which terminates in a quite small, flat, tapering cape. To the S. 64° W. we saw, also from the same point, a sheet of water lying behind the ranges on the southern shore. At first I took this for an independent lake; but it turned out later to be only a bay of the Tschargut-tso. The transverse glens that come down to the lake on north and south are particularly small and insignificant. The several bays end in latitudinal valleys running up between the littoral ranges. From a point of observation on the west side of the island I noticed three especially prominent capes in the S. 30° W., S. 54° W., and S. 76° W., and from the same point the second little rocky island of the Tschargut-tso lying to the S. 87° W. The larger island measures about 1300 m. at the maximum by 800 m. in breadth in its northern part and 400 m. in its southern; while the saddle-like depression is 300 m. broad. Thus the shape of the island was something of a surprise, in that its longer axis runs from north to south, whereas one would have expected it to stretch from east

to west, even as the lake does, and the surrounding mountain-ranges. Nevertheless the same parallelism can to a certain extent be observed in the island, for the two swellings might be regarded as fragments of two ranges stretching east and west. The space that intervenes between them consists entirely of soft disintegrated material and gravel; except on the actual beach-line all the fine material has been washed away, leaving the coarse sand and gravel behind. Grass and hard scrub were fairly common, and yak-droppings bore witness to the island being visited in winter. Faunal life was represented by gulls, small birds, spiders, grasshoppers, flies, humble-bees, gnats, and mosquitoes, enticed out of their hiding-places by the mild, bright weather. In open localities on the northern shore of the lake we observed large flocks of sheep, herds of yaks, and troops of horses, and in several places the encampments of the nomads.

Fig. 50. THE SAME.

The same persistent gale, with perfectly bright sky, continued all the 22nd September, and made it impossible for us the proceed. Nor did the wind abate until 9 p. m.; then however we crossed the middle of the lake to the second little island. Even from the highest outlook point on this island we were unable to form any idea as to how far the lake extended towards the west: it appeared to continue for a long way towards the S. 79° W., and beyond an isthmus in the same direction we observed a large sheet of water, though whether it was the extreme western part of the Tschargut-tso or an entirely fresh lake I could not make out. As it was night when we travelled from the one island to the other, it was impossible to note any details; a black outline showed where the girdle of encircling mountains ran, and we steered straight by the compass for the second little island. On the way I took the following soundings — 37.50, 35.80, 31.90, and 16.85; thus the lake-

bottom rises here towards the west, the greatest depth occurring quite close to the larger island. The night was unusually mild: at 11 p. m. the temperature of the air was 8.4° and that of the lake 11°.0.

Fig. 51. VIEWS FROM THE SMALL ISLAND OF TSCHARGUT-TSO.

A violent westerly gale blew again on the 23rd September. The second island, on which we were detained prisoners against our will, is triangular in shape. Its eastern side, which stretches towards the N. 20° E., is 230 m. long; the western, stretching to the N. 44° E., is 340 m., and the southern, which stretches from east to west, is 320 m. long. Thus the island is very small. Its southern part is com-

posed of a ridge of moderately coarse, beautiful red conglomerate, about 15 m. high and dipping 83° to the S. At its south-west end this ridge descends abruptly into the lake, while the shore of the island at its other extremity is littered with stones which have fallen from the summit and for the most part form a wall or

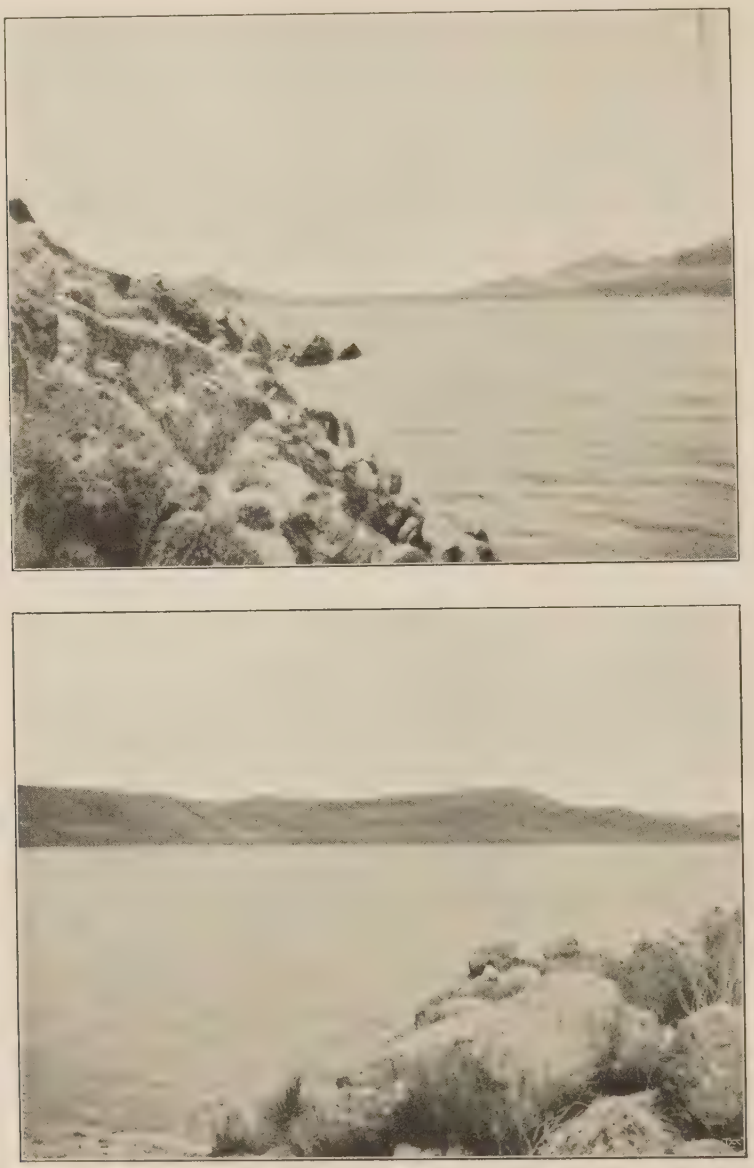


Fig. 52. VIEWS FROM THE SMALL ISLAND OF TSCHARGUT-TSO.

ridge a short distance back from the shore proper, giving rise in places to small strand-lagoons. The longest side, that facing north-west, also contains a number of similar fragments of stone, lying so thick together that we had some ado to get amongst them. The eastern side, on the contrary, consists of coarse

sand and fine gravel, the latter beautifully polished and rounded. In the middle of the island the vegetation was relatively abundant and the grass good. This island too is visited in the winter, as was also evident from the cairns of stones built upon the conglomerate ridge. Along the shores a low rampart can generally be distin-

Fig. 53. VIEWS FROM THE SMALL ISLAND OF TSCHARGUT-TSO.

guished, and on the inner side of it was some water. From the north-east corner projects a cape littered with stones.

As the afternoon wore on, the sky became clouded, presenting an extraordinary spectacle; for we were able to watch the progress of the separate squalls as

they raced along, especially across the mountainous regions on the south side of the lake, first whirling up the dust on the narrow flats beside the shore and then scattering over them, and more particularly over the mountains, a sprinkling of snow. By that the waves had subsided, though they were followed by a long, gentle swell. The following were the bearings of the features nearest to the little island: in the S. 26° W. and S. 55° W. appeared the ends of a small hammer-like ridge, forming a broad peninsula connected by a narrow neck of land with low ground behind, while a bay penetrates both east and west of it. The former of these bays is bounded on the east by a second peninsula, with three parallel ridges running down it, and of these three the most distant one, which bore from the S. 45° E. to the S. 68° E., appeared to fall pretty steeply into the lake. To the N. 75° E. lay the northern promontory of the large island and to the N. 73° E. the pier-like promontory on the mainland to the north. The peninsula to which this promontory belongs is very like that which I have just mentioned as existing on the southern shore, and like it is studded with three parallel ranges. Of the three, the innermost one, that is the one farthest north, terminates on the west in a rocky cape, which bore N. 3° W. On the southern shore of the lake we were able to distinguish generally four different ranges, each rising successively higher as they lay more remote from the lake, and the last one of all capped with snow.

Upon leaving the island we paddled towards the S. 66° W., steering for one of the rocky headlands on the south. At the same time we also left behind us the hammer-like peninsula and its round western bay, and beyond it we soon perceived the forks of two fresh, and somewhat more important, ranges. The outline of the northern shore was more difficult to make out; it appeared however to run more evenly, and not to be broken by rocky headlands or bays. Along this stretch of our journey, that is diagonally across the greatest basin of the lake, though nearer to the southern shore than to the northern, I was, in consequence of a fresh tempest which nearly cost us our lives, only able to take five soundings in all, namely the first immediately west-south-west of the little island 37.90 m., then 47.30, 47.85, and 45.00 m., and finally, close to the wild and picturesque southern rocky shore, 24.30 m. The maximum of these soundings, 47.85 m., is one of the very deepest which I have obtained in any of the Tibetan lakes; but it is very possible that the Tschargut-tso goes down to even greater depths on the north of the line that we steered. Thus the second little rocky island also rises from a considerable depth. Even at the very first glance, one would almost venture to say, that the lake must be relatively deep. Its basin lies, it is true, in a latitudinal valley, like so many of the lakes which we encountered in Central Tibet; but, while these lie in broad, flat valleys, and consequently must be shallow, as was, for instance, the big salt lake which we came across on the journey of the year preceding, the latitudinal valley of the Tschargut-tso is narrower, and is inclosed between steep mountain-ranges which advance right to the water's edge.

While the cliffs in this part of the lake dropped, so far as I was able to see, for the most part sheer into the water, the shore at Camp LXXXVII swept a long way inland, and was backed by relatively low ground: it was in fact a gravel scree which there touched the water's edge, and it was in part overgrown with

grass. The mountains in the same quarter consisted partly of conglomerate, partly of a light variety of rock, possibly quartzite: the dip was 60° towards the S. 35° E. At that point the lake narrows very appreciably, and the mountains which rise on the northern shore are of a somewhat different shape from those which we had hitherto seen. The main range nearest to the lake sends down to it several minor spurs, with short and small glens between them. On the flatter parts of the shore we again observed the tents and flocks of the nomads.

On the 24th September we traversed the last portion of the Tschargut-tso, namely its narrowest and most westerly part running towards the west-south-west. Our course ran nearer to the southern shore, and the depth there amounted to 13.95, 15.00, 5.50, 6.80, and 1.65 m. The mountain-range on the south is steeper and more craggy, and the gravelly scree at its foot also inclines steeply towards the lake, only one or two of its capes being flatter. On the northern shore there was on the contrary room for a broad strip of level ground. The lake narrowed still further, its tapering extremity swinging away towards the south. It is here that it is entered by the river Tsangmo-rapga, which issues from the large lake in the west, the name of which is, I was told diversely, the Addan-tso and the Nagma-tso. In its mouth lies a low sandy island. The river, which is not more than 1 km. in length, flows in almost a straight line from north-west to south-east, and is very uniform in breadth. It is so deep that the current is hardly noticeable, except in the relati vely shallow places, where I measured the volume, and there the current was lively. The breadth of the river was 35 m., its mean depth 2.79 m., and its mean velocity 0.205 m. in the second. The volume was consequently 20.02 cub.m. in the second. On 9th Sept. I found that the volume flowing out of the Tschargut-tso was 25.9 or in round numbers 26 cub.m.; but on 24th Sept. this lake was receiving 20 cub.m. in the second from the Addan-tso, and this notwithstanding the continuous evaporation. The difference of volume is of course simply due to the fact, that the latter measurement was taken 15 days later than the other, a difference of time calculated to produce a very appreciable effect at that season of the year. I have already stated, that there were no signs to indicate that the Jagju-rapga had been at a higher level during the summer that was just past, and that the river stood on 9th Sept. at what was approximately its maximum level. But I also considered it probable, that a drop might take place during the winter, though to what extent it would be impossible to form any idea, seeing that the conditions which exist in the drainage-area of the Addan-tso are unknown. All that is known to me in this regard seems to suggest, that the Addan-tso receives a pretty considerable volume. For to the south of this lake there is an extensive mountainous country with ranges running east and west. After a hard and stormy, though fortunately short, voyage across the extreme eastern bay of the lake, we landed at a point upon which we beheld conspicuous peaks, capped with perpetual snow, to the S. 3° W., S. 13° W., and S. 48° W. An hour later we crossed over a pass on the northern shore, from which we obtained another magnificent view of the mountainous country to the south, and especially of two transverse glens opening in the S. 9° W. and S. 29° W. Even at the great distance at which we then were, we could see that streams of no inconsiderable size were making their

way through them to the lake, for on the flat land below their mouths there were winding ribbons of glancing silver. Moreover two of my men, one of them a Cossack, who had been out in search of me along the western and southern shores of the Addan-tso, and met us here at the Tsangmo-rapga, told me, that they had passed not less than eight active streams, all of which issued out of the mountains to the south, and one of these was especially broad and full of water, though not very deep, only reaching up to their horses' knees.

Ljustr. A. B. Lagrelius & Westphal.

VIEWS OF THE SOUTHERN SIDE OF THE LITTLE ISLAND OF TSCHARGUT-TSO.

CHAPTER VII.

THE ADDAN-TSO. COMMENTS ON THIS LACUSTRINE GROUP — THE DAGTSE-TSO.

Bower gives us the following information, first of the route after quitting his Camp 45: »On leaving camp we went through a narrow defile that opened out on a wide valley in which was an enormous lake». This lake cannot, as I will show later on, be any other than the Addan-tso. With regard to the stage to camp 47 he says further:

»Soon after leaving the last camp we found ourselves on the banks of a large stream flowing into the lake. Although it was cut up into many branches, it took us some time to find a ford, and then we only got over with difficulty, all our bedding and baggage getting wet. Another stream farther on, though it did not hold nearly as much water, was almost as difficult to cross, owing to the stony nature of the bottom and the force of the current. After crossing it, we turned up a valley on the south and camped.» When returning, *i. e.* on the road, to camp 56, Bower writes thus in his *Diary*: »Halfway we stopped and had tea with our Tibetan friends and then passing our old camp, N:o 48, camped where a fairly large stream, issuing from the snowy mountains on our south, flowed towards the large lake on our north. Another big lake was described to us as lying to the north-west. I made inquiries as to when we were to turn north, and was told just west of Chargat Cho; but the question was, where was the Chargat Cho? for, amongst other names, nearly every lake we had seen had been called Chargat Cho.» The following describes the next day's journey to Camp 57: »On the march the large river that had given us a good deal of trouble in fording was recrossed; the water had fallen, but was still pretty deep, and a couple of Tibetans on yaks, who were showing the way, came on a deep bit suddenly; yaks and men disappeared under the water». Finally I may quote the following passage descriptive of the march to Camp 58: »A pleasant easy march up the western edge of the lake. From camp a beautiful view down the lake was obtained, with an island in the foreground, called, in memory of some great legendary warrior, Spamo's Helmet. Near where the rivers enter on the south-west side, the water had quite a greenish colour, but towards the other end it was bright blue.»*

* Op. cit., pp. 76 and 106.

There are various reasons why I assume that the lake which Bower calls Chargat Cho is identical with my Addan-tso. For one thing, on Bower's map the distance between the Chargat Cho and the Garing Cho (i. e. Selling-tso) is 55 km., whereas I found that the distance between the Selling-tso and the Tschargut-tso amounts to only 22 km., but the distance of 55 km. does agree excellently well with the distance between the Selling-tso and the Addan-tso. Further we are told about several rivers flowing down towards the lake from the snowy mountains on the south and emptying especially at its south-west corner; and this agrees with what I myself and my scouts observed to be the case with regard to the Addan-tso, while there are no such rivers entering the Tschargut-tso. Again, Bower says nothing about a river issuing from the lake; on the contrary he represents the Chargat Cho and the Garing Cho as two quite independent basins, separated from one another by an isthmus. He speaks of there being an inconsiderable difference of elevation between the freshwater lake and the saltwater lake, but in this he is so far incorrect in that he makes the latter lie higher than the former. The altitude that he gives for the Chargat Cho (15,348 ft) agrees tolerably well with the elevation which I obtained for the Addan-tso, namely 15,125 ft. From all this it results that the two last-named lakes are identical, and that Bower did not see the real Tschargut-tso at all, but travelled on the south side of the mountains which stand on its southern shore. Similarly he was separated by mountains from the valley of the Jagju-rapga, and consequently *could* have *no idea* that any water connection existed between his Chargat Cho and Garing Cho. As his route ran from west to east, and back again the same way, there was nothing to bring him at any point into contact with the Jagju-rapga. The river which is shown on his map coming from the west, and emptying into the Garing Cho, is probably identical with my Alan-tsangpo.

Nevertheless — and this is the most important conclusion that can be drawn from the passages which I have quoted from Bower — we find that the Addan-tso really does receive a considerable quantity of water from the south. On the 9th October the biggest river contained, according to Bower, a less volume than on the 2nd September, though even then it was a noteworthy stream. His map shows five rivers entering the lake and all coming from the snowy mountains on the south; but, on the contrary, not a single one from the north, east, or north-west, and this again agrees perfectly with my own observations. In this respect the Addan-tso is like the Naktsong-tso, which likewise derives all its tributaries from the south, from the same latitudinal mountain-range. But in the Selling-tso the case is different: this lake receives its most important tributary from the north-east, but that tributary, the Satschu-tsangpo, originates in a vast mountainous region at a considerable distance away.

Trotter, on the strength of Nain Singh's wonderful journey, assigns to the Tschargut-tso a position and a rank that are altogether exaggerated. He says with regard to it:

»It appears that the drainage from nearly all these lakes finds its way either into the Chargut Cho, a large lake said to be twice the size of any with which we are as yet acquainted in these parts, or into the Nák-chu-khá, or Hotá Sangpo, a large river which issues from the Chargut Cho and flows eastward. The southern

banks of this river are said to be inhabited at certain times of the year by shepherds from the Dé Namru district (north of Dé Cherik). The country to the north of the Nák-chu-khá is believed to be uninhabited.»*

By »all these lakes» he means the Chikut Cho, Kyaring Cho, Mokien Cho, and Namcho or Tengri-nor, and several others, an assumption which is of course absurd, for it is in direct conflict with both the orographical and the hydrographical structure of the Tibetan highlands. Even to one who possesses no knowledge of the country, the hydrographical arrangement of his map presents a very improbable appearance — an immense lake receiving rivers that issue out of a series of other lakes lying west, south, and south-east of it. Even the Tengri-nor is made to send out an emissary, if not to the Tschargut-tso itself, at all events to the river which issues from the Tschargut-tso and flows east. As a matter of fact we know now, through the investigations which have been carried on since Nain Singh's time, that the country in that particular locality does not slope from south to north, but from north to south, and that the lakes, situated at different latitudes, are sharply separated from one another by mountain-ranges running east and west. The position of Nain Singh's Chargut Cho is fairly correct, and thus serves as a confirmation of the name of Tschargut-tso, which was given to me as the name of the lake which I have described above. The only thing is, that on his map the lake is put a little too far towards the north, and its size is considerably exaggerated, being made actually twice as great as the Tengri-nor.

Pl. 65 of my atlas will give a comprehensive idea of this interesting country, of which I was only able to make an all too cursory examination, though it is a country that would well repay a close and detailed investigation. Here I will only briefly recapitulate the connections that link the different lakes together. We have, a long way to the west, the Addan-tso, a medium-sized, compact lake, with a single basin, in which I was unable to detect any islands; although, according to Bower, it does contain one near its south-west corner. According to the map of the same traveller, there are no noteworthy bays or promontories on its southern or western shores, and in this respect it is very unlike the Tschargut-tso, with its fantastic and involved outline. On the east side the Addan-tso is divided into two bays by a peninsula that juts out to the west, and on it are two mountain-ranges, the northern one quite short and detached, while the one to the south clearly forms the continuation of the main chain that borders on the south the valley of the Jagju-rapga and the Tschargut-tso, while its eastern end runs out in the same way towards the shore of the Selling-tso, where again it gives rise, by means of a similar, though smaller, cleavage, to two bays. On the northern side of this peninsula there is an indentation towards the south, just as though a notch had been cut out of it, and into this notch fits a flat peninsula that projects southwards from the northern shore of the lake; it is between these two peninsulas that the river Tsangmo-rapga enters. Along the northern side of the lake runs a big mountain-range, which sends off minor spurs at intervals towards the lake. As a rule a strip of flat strand is left between the foot of the mountains and the water's edge, dotted with several long, narrow

* H. Trotter, *Account of the Pundit's Journey in Great Tibet from Leh in Ladakh to Lhása*, in *Journal of the Royal Geogr. Soc.*, vol. XLVII p. 110 (1877).

lagoons; one small portion of the range in the west appears however to plunge abruptly down into the lake. The Addan-tso forms, as we have seen, the receptacle for the surface-water that gathers off a pretty considerable area, the greater part of which lies apparently south of the lake. The reason why the Tschargut-tso does not receive any tributaries from the south is probably simply this, that the latitudinal valleys which lie on that side drain westwards into the more southerly of the two eastern bays of the Addan-tso, and eastwards into the upper course of the Alan-tsangpo, and more especially into the Selling-tso. The water of the Addan-tso flows out through the Tsangmo-rapga and empties into the Tschargut-tso, that stream being the only affluent of the latter lake, except for the brooks which enter it directly during the rainy season. After leaving the Tschargut-tso, which is thus nothing more than a »half-way house», a gigantic fluvial ganglion, the water continues through the Jagju-rapga eastwards into the Selling-tso. This lake occupies the very lowest part of the entire basin, and is therefore its terminal lake, so that its water is salt. In contradistinction to the Satschu-tsangpo and the Alan-tsangpo, and the other two lakes emptying themselves into the Selling-tso that we have already made acquaintance with, the Jagju-rapga maintains, we have assumed, a certain constancy of level throughout the whole of the year, the reason of this being that it receives its water from a rather large freshwater lake, the gathering-basin of a pretty extensive area; moreover the Tschargut-tso also acts as a moderator to its northern neighbour, the Selling-tso, which still further distributes and equalises the volume, tending to render it as far as possible independent of the seasons. I do not of course mean to say, that there is no fluctuation of volume in the Jagju-rapga, but it is probably very slight. To obtain absolute certainty upon this point would require a visit to that lacustrine region in winter.

It is however of great interest to turn to the very distinctly marked and beautiful old beach-lines and step-like terraces which occur on the northern shore of the northern bay of the Addan-tso and on the western shore of the northern peninsula. In the former locality I did not observe more than two terraces, but in the latter three, and of these the highest may be fully 10 to 15 m. above the existing level of the lake; hence these terraces clearly correspond to the shore-ramparts which I had previously seen on the western side of the first rocky island in the Tschargut-tso. As for this peninsula, it is curious, that these ramparts are formed on its western shore only, but are totally absent on its eastern side, the explanation being of course the same as that which applies in the case of the island, namely the prevalence of westerly winds and the effects which they produce upon the western shore through the instrumentality of the violent waves and their surf-beat. The two lowest terraces on the northern shore of the bay and on the western shore of the peninsula belong of course together notwithstanding that they are in a couple of places broken, and even obliterated. There are no terraces on that part of the west side of the peninsula which lies under the shelter of the more northerly range on the southern peninsula. The existence of the two upper terraces are more difficult to explain, for both slope inwards towards each other, and thus can hardly be regarded as having anything to do with a higher water-level at some former period, but rather they would appear to represent the traces of the border-rim of

a bay of the Tschargut-tso, the rudiment of which still survives in the form of a little bay. However that may be, the two lower terraces at all events are a proof that the level of the Addan-tso was formerly higher than it is now. Nobody, I suppose, would maintain, that these beach-lines have been made by fluctuations of level at the present time; that would be tantamount to asserting that the Addan-tso rises several meters in the spring when the snows begin to melt on the mountains to the south, or later in the summer and in the autumn during the rainy season. For in proportion as the inflow into the lake increases so will its outflow through the Tsangmo-rapga, and the resultant effect at any rate will be, that the lake will maintain itself at the same level. Such fluctuations as do take place in its *niveau* are certainly so insignificant that they cannot under any circumstances be brought into connection with the terraces in question. Around the Selling-tso I found terraces the altitude of which above the existing level of the lake I estimated at about 50 m.; and the shrinkage that is going on in that lake I attribute to a diminution in the rainfall. To the same cause we must also ascribe the drop in the two freshwater lakes, though in them the subsidence takes place much more slowly, for in their case another factor steps in as a modifying agent, namely fluvial erosion. For if you conceive these two lakes to have been ten meters higher than they are now, that is to say as running together to form one long lake, with a narrow sound between them, the shape of which can be outlined thanks to the terraces on the peninsula, then the level of the Jagju-rapga would also have been ten meters higher than it is now, otherwise a position of equilibrium could not possibly be maintained. In order to bring about a drop of ten meters in the lakes, that is to bring them down to the level at which they now stand, an erosion to that same amount must be posited in the Jagju-rapga. This erosive activity is still going on, and is accompanied by a parallel fall in the two freshwater lakes. But if we suppose the diminution in the rainfall to take place so rapidly that the erosive activity of the river is unable to keep pace with it, then we should sooner or later have this result, that the Tschargut-tso would cease to emit any water into the Jagju-rapga, but on the contrary would become cut off from it and would gradually turn salt. And the same fate would happen to the Addan-tso. Later on we shall come across lakes in which this process actually has taken place, and amongst these are instances of lakes which are on the point of totally disappearing off the face of the earth.

As for the fourth member in this peculiar lacustrine family, namely the Nak-tsong-tso, we have ascertained that it occupies a more independent position than the other two freshwater lakes; for, while it does receive affluents from the south and west, it has, on the other hand, no visible outflow.

Leaving behind us the north-west bay of the Addan-tso, we travelled for some distance westwards along its northern shore, then struck off to the north-west, making for a not particularly high pass in the range which separates this lacustrine valley from the next latitudinal valley to the north, and which, I imagine, is the one along which Littledale travelled. Here we found various small freshwater pools and numerous nomad tents. In the district in which we pitched Camp LXXXVIII, at an altitude of 4,686 m. the grazing was not particularly good. Meanwhile the caravan had made its way from Camp LXXXIV on the east side of the Tschargut-

tso by a latitudinal valley north of the lake, and through the districts of Churmi and Dähling. The next mountain-range to the north was called, they were told, Jeru-dschandsching.

September 25th. The narrow latitudinal valley which we had followed debouched at Camp LXXXVIII into a very broad latitudinal valley, and in this we continued our journey towards the west. The day was raw and cold, and nearly all day half a gale blew from the west, the sky being everywhere hung with heavy blue-black clouds, though they discharged merely a slight drizzle once or twice; of the sun there was not a glimpse to be seen. We were speedily to discover that winter was already making its approach with rapid strides. The rainy season had come to an end, and was succeeded by the period of constant westerly winds, which after a couple of breaks increased steadily in both duration and strength. We were thus travelling under peculiar and not very favourable conditions. For the thorough exploration of a country it is above all indispensable that the explorer should enjoy perfect freedom of action and not be hampered by the annoying attentions of troops of Tibetan mounted men. Another equally indispensable condition is, that he should have a strong and mobile caravan, and not one greatly reduced in both numbers and strength, such as mine was then. We were, it is true, to be soon supplied with Tibetan yaks, which came to carry our baggage; but our escort had received stringent orders from Lhasa, and were not to be induced to turn aside to either right or left. Last, but not least, there is a limit even to the traveller's own endurance, and we had already been travelling so long on those stupendous altitudes, that we literally were quite unable to face any fatigue that was not absolutely unavoidable. For these reasons during the greater part of the way to Ladak I had to keep faithfully to the latitudinal valleys, which of course entails a one-sided and monotonous view of the region traversed. All the same I still continued my mapping on the same minute lines as hitherto, and by means of this long itinerary I obtained an especially accurate and valuable general idea of that part of Tibet and of the character of the latitudinal valleys in the central parts of the country, just as in 1896 I acquired a similar fair grasp of the character of the latitudinal valleys of northern Tibet. And even though the orography was monotonous, yet the work which I thus carried out, under extremely difficult circumstances, will find its right place as soon as the country to the north and to the south of my route has been explored with equal minuteness, and when my latitudinal valleys have been crossed at several points and been compared with their neighbours to north and south. I did, it is true, come at several points into contact with Littledale's route; but, notwithstanding that I endeavoured to avoid it as far as possible, I do not think that any real harm has been done, for in point of accuracy Littledale's map leaves much to be desired. In the majority of cases it was difficult to identify the points where our routes intersected; but whenever they did intersect I will for the future call attention to the fact.

Meanwhile we were marching along the great open latitudinal valley, the mean breadth of which would be about 30 km. On the north it is bounded by a short, but imposing, snowy range, though the greater part of its snow appeared to have fallen recently, and consequently had not lain there all the summer. Below

this, to the south, runs another range, lower and parallel with the first range. In the middle of the valley there are occasional stretches of minor hills. The mountains on the south, that is to say the westward continuation of the range last crossed over, on the northern shore of the Addan-tso, is considerably lower than the opposite range on the north of the valley, but on the other hand its outlines are wild and fantastic: there was not a single point where it would have been possible to cross the range with camels. Towards the north-west and west-north-west the country is very flat, the only diversities being some low hills. And the same thing is true of the country to the west, that is in the direction in which our latitudinal valley was running. I was told that this southern range is called Kondo. After we had passed a spring called Biji, we travelled for a while towards the south-west, keeping faithfully to the foot of the southern mountains, sometimes crossing over flat spurs that jut out from it, as also shallow dry gullies. On the right we passed a small free-standing butte.

During this day's march we counted no less than 32 black tents belonging to the nomads, all of them standing on the slopes of the southern mountains, and here too, although the grass was but poor, large flocks were grazing. My Lama, who visited several of the tents, told me that they contained 2, and at the most 8, persons each. If we knew the number of latitudinal valleys in this inhabited part of Tibet, and knew the grazing capability of each valley, we should be able to make a provisional calculation as to the numbers of the population. It must however be remembered that the population increases as you proceed south from the country through which we were then travelling, but towards the north it thins away and soon ceases; indeed it is probable that north of our latitudinal valley there was but a small number of tents, and in some places none at all. Our knowledge of the general geography of Tibet is however all too scanty to admit of any reliable conclusions being arrived at on this topic. The range of Kondo may in a certain sense be regarded as a geographical boundary. South of it the relief of the country is very capricious and irregular, a chaos of mountain-ranges, most of them stretching east and west, and the latitudinal valleys between them are largely occupied with lakes; and so it continues as far as the great snowy range, which separates this lacustrine region from a similar region farther to the south, in which lie the lakes Dangra-jum-tso, Nganzi-tso, Daru-tso, Kyaring-tso, Mokien-tso, and several others, all known since Nain Singh's journey. North of the Kondo range the highlands are more plateau-like, although even there big ranges run from east to west. In a later chapter I propose to bring together for comparison a number of profiles, based upon our existing knowledge of Tibet.

The only transverse glens that bear names appear to be those which possess springs in their entrance; one of these, known as Urumi, contained springs, marshes, grazing, and four tents. Here began a little foot-hill range, fairly well defined; this we passed at some distance. Our camp that evening, in the district of Schalung or Dagdi, was also situated close to some marshes formed by springs and near them were several open freshwater pools. Not far away ends the little range from which a number of gullies and watercourses descend towards the north, all difficult to cross over and tiring to both man and beast: they were 3 to 4 m. deep and were all crossed at right angles.

The camp just mentioned, the altitude of which was 4,609 m., stood 40 to 50 m. above an oblong or oval-shaped lake situated in the middle of the latitudinal valley. This lake was said to be called the Dagtse-tso; its eastern end was a few kilometers to the north of our camp. It forms the predominant feature in the scene, and north-west of it several lofty summits towered above the mountain-range that rises in that quarter. In shape this new lake is very unlike those we had recently been travelling amongst. In the case of the latter the mountains advance quite close to the water's edge, and even rise out of it in the form of islands; whereas the Dagtse-tso is certainly a very shallow sheet of water, and it lies at a great distance from all the surrounding mountains, and has flat, rounded shores, above which it was easy to see, even from a distance, distinct traces of an older, higher beach-line and proofs that this lake, like the Selling-tso, is undergoing a process of desiccation. But the process appears to be going on at a more rapid rate in the Dagtse-tso than in the Selling-tso. At the eastern end of the former we counted eight distinct chains or rings of lagoons, arranged concentrically and forming long, narrow sheets of water, interrupted at intervals, the yellow colour of which contrasted with the pure blue water of the lake. It is abundantly clear, that these collections of water are dammed up by older strand-ramparts, and that they are fed by springs close at hand. Seen from a little distance, these lagoons present a rather unusual appearance; surprise is created not only by their irregular position and structure, but also by the fact that all of them, the lowest as well as the highest, are able to contain water. Pl. 66 of my atlas will give an idea of their arrangement. The positions, with intervals of almost equal distance between the broken rings, point to a regular progressive rate in the shrinkage of the lake. There are also lagoons and ancient beach-lines on the southern shore of the lake; but they are of quite a different character, being smaller, more scattered, and not concentrically arranged, parallel with the shore. It is worth noting, that these strand-ramparts are especially developed at the eastern end of the lake, that is to say at that end upon which the waves beat with the greatest violence, driven as they are by the prevailing westerly winds, and consequently at that part of the lake in which the strand-ramparts are being built up with the greatest degree of energy.

September 26th. From Schalung we travelled towards the west-south-west, keeping a couple of kilometers from the southern shore of the lake. The little red detached range soon came to an end, and in place of it we had on our left hand a bigger and more accentuated range, situated farther to the south. In the entrance to its transverse glens freshwater springs not seldom leap out, though the yield of water is small. It was in their vicinity that the 16 nomad tents stood which we observed on this day's journey. We left close on our right hand several freshwater pools, some containing muddy yellow water, others water that was of perfect limpidity. The country between our route and the lake was level, and abounded in pools and marshes; it was with the very object of avoiding this marshy and treacherous ground that we travelled at such a distance from the lake. The shore-line is regular, possessing neither bays nor promontories. The water was rather salt, its sp. gr. being 1.043. Notwithstanding the proximity of human

beings and domestic live-stock animal life was fairly abundant beside the lake; kulans and antelopes were especially numerous, and there were also hares, partridges, and gulls.

Of the transverse glens that come out of the mountains on the south, several are of pretty fair size. Upon reaching the largest of these, we turned north-west, for we were now approaching the western part of the oval-shaped Dagtse-tso. Generally the surface was level and good for travelling, except that the gullies which issue out of the mountains to the south were deeply excavated. Of these only one at that time carried water, a mere trickle issuing out of a spring situated just above our track. In three places we crossed over old beach-lines, all wonderfully distinct and sharply outlined. They resembled rounded terraces with steep slopes next the lake. The first of the three was however more like a wall, and at its southern foot a lagoon is sometimes formed by a temporary brook, judging at least from the cracked, yellow deposit of clay which we found there. In the neighbourhood of the recently mentioned watercourse that did carry water, seven strand-ramparts were to be counted, smaller than those mentioned before, but all the same distinctly marked and arranged amphitheatrically and concentrically. Strand-ramparts like these accompany faithfully the shores of every salt lake in Central and Western Tibet. We have already encountered them beside the Selling-tso, and we shall come across even more beautiful examples later on. The peculiar conformation of the surface which now came into view on our left hand also bears witness to the desiccation of the Dagtse-tso. The foothills on the south consist of a somewhat detached, reddish range, and they descend by an abrupt, step-like terrace towards the north-east, and finally thrust out, still in the same direction, an offshoot shaped like a pier or wall, which forms the dividing-line between two sheets of water not directly connected with the Dagtse-tso. South-west of this »wall» there stretches a long, but small, lake, which is fed by a stream that comes from the south-west and possesses no visible emissary into the lake. Its water had a slightly saline flavour; around it are marshes and pools, and on these were thousands of gulls and a couple of hundred of wild-geese. On the north-east of the same dividing-line there is a long, narrow sheet of water, which in places bears a striking resemblance to an old river-bed. The water in it was fresh and bright, and it contained an abundance of grass and of wild-geese. On its northern shore stand some low hills of barren, yellow clay. This sheet of water is also connected with extensive marshes, which reach all the way down to the shore of the principal lake, though, so far as we were able to see, they do not communicate with it directly. On the surface of this long stretch of water we observed current movements here and there setting in different directions, the inference being that they have their origin in springs. Amongst the marshes, as also along the whole of the southern shore of the lake, the grazing was relatively good; but along our line of march the ground was practically barren. At the foot of the pier-like dividing-wall there was not a trace of vegetation to be seen; the ground there is sometimes overflowed by rain-water charged with sediment, and is as level as a floor. Later on, as we drew near to the embouchure of the Bogtsang-tsangpo, the grazing increased a little in quantity, but still continued poor in quality. Camp XC (4549 m.) was pitched on the

right or southern bank of the river and a few meters above the surface of the lake. The river is there divided into several arms, and bordered on the south by a clearly outlined strand-terrace. The actual outfall into the lake is situated several kilometers towards the north-east, not far south of a little isolated mountain which rises on the north-west shore of the Dagtse-tso. In this region we discovered three nomad tents.

Fig. 54.

The main range that runs north of the latitudinal valley in which the lake is situated is crowned by an immense round-topped snowy mass and by several smaller snowy summits; and there were also some rudimentary glacier-arms. During the day the wind had blown hard from the west, and about three in the afternoon it was followed by a couple of showers of rain. Next day, which we devoted to rest, the weather was, on the contrary, astonishingly warm and still, and the air was actually full of buzzing flies. Then followed a sort of Indian summer, though of the briefest, for it only lasted a couple of days; still it was pleasant and beneficial to the caravan.

CHAPTER VIII.

TRAVELLING BESIDE THE BOGTSANG-TSANGPO.

September 28th. West and south-west of the Dagtse-tso (called Tuktsitukar-tso on Littledale's map) three parallel latitudinal valleys can be clearly distinguished. So far as one can judge from Littledale's map, he appears to have travelled along the most northerly of these and to have crossed the river once only, and that not very far west of the lake, but after that to have left its valley for good. I, on the contrary, followed the middle valley, and in this region my route is separated from the English traveller's by a range of moderate elevation, running on the whole from east to west and broken in places. A great part of the middle valley is occupied by the Bogtsang-tsangpo. This river in the eastern end of its valley breaks through the bordering range on the south, and flows for a short distance in the most southerly of the three latitudinal valleys, and then once more cuts its way through the same range and so returns to its original valley, along which it winds down to the lake. On the way it makes a bend to the north and appears to flow pretty close to the southern foot of the extreme eastern portion of the range which separates the middle valley from its next neighbour on the north, that is to say the same range that separated my route from Littledale's.

Accordingly when we resumed our march from Camp XC towards the west-south-west, across the flat plain that surrounds the lake, a plain bearing thin steppe vegetation in a sporadic fashion, we soon drew away out of sight of the river, nor did we see it again until after we had entered the middle valley. At its eastern end however we crossed the river at a point where it was flowing from the S. 6° W., and where the breach is situated by which it cuts through the southern range. I had intended faithfully following the course of the river, so as to map it throughout. The existence of the Bogtsang-tsangpo was already known, first through Nain Singh,

Fig. 55. LOOKING N 60° E FROM CAMP XC.

and afterwards through Littledale; but we possessed no map of it. With our heavy and unwieldy camel caravan, it proved, however, impossible to penetrate through the transverse glen. A couple of my Cossacks, who went to reconnoitre it, reported that it was narrow and rugged, and was shut in by precipitous cliffs, forming a deep gorge, at the bottom of which the river churned its way along. This transverse glen is said to merge towards the west into the most southerly of the three latitudinal valleys; and in fact that valley appears to be far narrower, and to present far greater difficulties, than the other two to the north of it. It is said to be especially precipitous on its northern side and in places to descend sheer into the river like a wall. Through the gap made by the transverse glen we perceived at some distance to the south-west a fresh mountain-range, of moderate elevation and capped with snow. At the point where we now forded the river, it was divided into four small arms and two bigger ones, the aggregate volume of the whole being about 6 to 7 cub.m. in the second. As the volume a little higher up was somewhat less, it is probable that the river is not joined by any tributary before piercing through the transverse glen. And as the volume at Camp XC can hardly have been more than 3 cub.m., it is quite conceivable that the river divides just above its embouchure into an even greater number of arms than those which I saw. From the same ford we observed to the north a small lake, forming a sort of continuation of the Dagtse-tso. The small lake south of Camp XC is fed through a big glen that pierces the southern range, and in the outlet of which we perceived two nomad tents, the only ones we saw during the course of this day's march.

Fig. 56. NEAR CAMP XC.

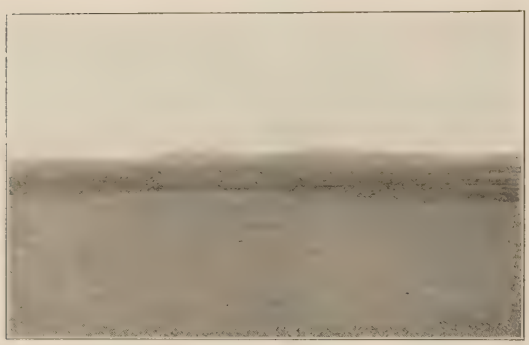


Fig. 57. S 35° E FROM CAMP XC.

We left the river therefore on our left, behind the red mountain range, with a sharp crest, that borders its glen on the south. The middle latitudinal valley, up which we were marching, grew more and more broken, and we soon entered a distinct gorge, a deep-cut eroded watercourse inclosed between low, but steep, hills. These were composed almost entirely of soft disintegration material; but occasionally in the deeper incisions the hard rock cropped out, a red sandstone, very severely weathered, and dipping 25° to the S. 12° W. The gorge was very sinuous and the ascent not inconsiderable. In one or two of the deeper places in the bed of the watercourse there were small pools left after the last rain. From both sides

the gorge is joined by several similar ravines, all deeply cut and all without water. At length the gorge opened out again and we began to march along a level, slowly ascending swelling, that rises between two main watercourses, which unite to make the gorge I have just described. Here we found, though in insular patches, as in the main valley, fairly good grass, tall, but yellow and hard, such as it usually gets towards autumn. The valley was now inclosed between two small mountain-ranges, steeper and with sharply defined crests; in the southern one is the summit O_2. The two main watercourses run each at the foot of one of these two ranges. The altitude of Camp XCI was 4637 m. In its vicinity a hundred tame yaks were grazing; so that there were nomads in the neighbourhood. Our Tibetan attendants called this region Bigdo.

Fig. 58. VALLEY OF THE BOGTSANG-TSANGPO.

When we compare the three latitudinal valleys together, the following principal differences may be observed between them. The one farthest north is broad, open, and level, and possesses no distinct watercourse — according to Littledale. The middle one, which we were following, is considerably narrower, its floor very appreciably broken, and its watercourse energetically developed. The southern valley, along which the Bogtsang-tsangpo flows, is, according to the report of my Cossacks, in point of relief even more wild and inaccessible than the middle valley. These differences reflect on a small scale the peculiarities which on a large scale characterise the Tibetan highlands, that is to say in its central and more northerly parts predominantly plateau formations with open, flat, broad latitudinal valleys; but in the south a more accentuated relief, with narrow latitudinal valleys, more seldom plateau country. Nevertheless there do exist in Southern Tibet, at the northern foot of the Himalayas, plateau-like regions of the same kind as those which are so common at the southern foot of the Kwen-lun.

September 29th. We still continued up the latitudinal valley towards the west-south-west, at first ascending imperceptibly to a flat pass, only a couple of

meters higher than Camp XCI. On the other side of it we again went gently down, until we at length struck the Bogtsang-tsangpo, and then we once more marched up alongside it. This day too was, like those that preceded it, a warm summer day; indeed in the afternoon we even found the sun irksome as it shone in our faces, causing our skin to dry up, crack, and peel off in large flakes.

Fig. 59. THE BOGTSANG-TSANGPO.

On the little pass my aneroids registered 4639 m.; but, despite the slightness of the relative altitude, we enjoyed from it a pretty extensive view. To the west-north-west we saw, through a broad, level gap, the latitudinal valley in which Littledale travelled, and which my Tibetan escort repeatedly endeavoured to induce me to follow, probably because they looked upon that road as finally and completely abandoned, as well as in so far of less consequence, owing to the fact that it is in general very difficult to find a road over the great mountain-range on the south down into Tibet proper, or as my escort phrased it, into the »Land of the Holy Books». The latitudinal valley, that is to say the actual valley of the Bogtsang-tsangpo, appeared to stretch as far as ever we could see towards the west-south-west.

As we marched down from the pass, we had at first on our right some low and insignificant hills, and on our left broken country, through which all the water-courses make their way down to the Bogtsang-tsangpo. Upon coming to a fresh-water pool, fed by springs, we found large flocks of sheep grazing; the grass was in patches exceptionally good.

After passing on our left a small mountain knob, rising above the otherwise soft ground, we once more caught sight of the Bogtsang-tsangpo, winding with short, sharp bends immediately south of our line of march. At first it looked so

intricate and involved that it was difficult to form any idea as to where it came from or whither it went to; but after advancing a little bit farther, we ascertained that it came from the west-south-west, and then trended towards the south-east, at the same time forcing its way by a more open glen through the southern range, which just there is relatively low, and then, as we have seen, it turns towards the east and north-east. It is joined by several side-glens, especially from the south, but all without water; still it is possible that some of them which originate on the peak N_2, visible to the south, and on the range of moderate elevation to which it belongs, do carry water. Thus the orographical and hydrographical conformation is here rather peculiar and unusual: the bottom of the latitudinal valley forms such a vast swelling, rising up to the pass just mentioned, that the river prefers to force its way twice through the range on the south, a range, it is true, of no great magnitude, before it finally turns towards the salt lake into which it empties.

Fig. 60. LOOKING DOWN THE RIVER FROM CAMP XCII.

The country above the first breach is also of a more unusual character. The river there winds backwards and forwards across an almost level region, or if not level it inclines exceedingly slightly towards the east, and consists exclusively of soft, finely divided material, originally alluvial, and now abundantly overgrown with grass, and in places marshy and boggy. The current was moving very slowly, the water was not quite clear, and I was amazed to find, that a little lower down the stream

possessed so much energy as to carve its way through the mountains to the south. Neither here nor farther west does the Bogtsang-tsangpo resemble the usual mountain streams, with their deep cut, gravelly bed, their strongly accentuated erosion terraces, and turbulent torrent. The river seems rather to have entered upon a stage of apathy, after having in the preceding section done its real erosive work, and levelled and filled up its latitudinal valley. In the section which I am considering it does, it is true, possess a terraced bank, at all events on its left, and this, while not very high, is quite distinct, and situated at a considerable distance from its existing bed. Between the terrace and the river-bed stretches the marshy region which I have recently mentioned, and there there are a number of typical backwater loops, that is windings of the river cut off from it, of precisely the same character as the *boldschemals* of the Tarim. Some of these loops were still full of water, others were empty. Formations such as this would not be able to come into existence, had not the country been so levelled up and smoothed by older alluvia. The appearance of the river is calculated to deceive one as to its dimensions. The Bogtsang-tsangpo looks like a respectable stream, but its deep, broad current moves at such a slow rate that the volume does not amount to more than a few cubic metres in the second. And the deception is still further enhanced by the fact that the banks are very low and rise but little above the water-level; although sharply outlined and steep, they are seldom more than 1 m. high. In a word, the river-bed appeared to be exceptionally full for so late a season of the year. As vast quantities of water make their way down into this important channel after rain falls over the drainage-area of the Bogtsang-tsangpo, it is probable that in some places the river overflows its banks. For instance, at the place where we again forded it the land adjacent to the banks, being still wet, were slippery and greasy. The bottom of the river consisted however of fine gravel. On the whole the stream flowed at that spot in one collected channel, though in a few places it divides into two arms passing round small alluvial islands.

Fig. 61. LOOKING UP THE RIVER FROM CAMP XCII.

Fig. 62. FISHING AT CAMP XCII.

After travelling for an hour at some distance south of the river, we again approached it at a point where a rocky promontory juts out from the southern

ISOLATED MOUNTAIN NORTH OF CAMP XCII.

Lith. A. B. Lagrelius & Westphal.

CONTINUATION TO THE RIGHT OF THE SAME.

mountains, in that the sharply defined range, precipitous next the river, describes a curve concave towards the north, and close in under its foot creeps the river; at the promontory the rocky wall is practically vertical. The rock was a hard, red, fine-grained variety, dipping 33° towards the N. 30° E. In this locality the Bogtsang-tsangpo forms a peculiarly extensive overflow region, for from the principal river, which hugs the base of the range, at least half a dozen branches break away and then lower down turn in diagonally and successively rejoin the main stream. At the same time these branches split up into yet smaller ones, all of which we had to ford. One of these was almost as big as the principal river flowing underneath the promontory. The ground beside these branches was as a rule barren

Fig. 63. MOUNTAINS ON THE SOUTHERN SIDE OF THE BOGTSANG-TSANGPO.

and marshy. Thus here again the Bogtsang-tsangpo is not quite decided in its course; in other words, it has advanced to such a stage in its levelling work, that it is no longer able to retain its bed, but, breaking out of it, gropes its way forward. At the next point at which we struck the united river, we made Camp XCII at an altitude of 4623 m., that is a good deal lower than the little pass in the latitudinal valley and 30 m. higher than the point where the river divides into so many branches. Immediately north of our camp rose a fairly accentuated mountain-mass, which, I was informed, is called Muktschak. The mountains on the south form, on the other hand, a higher and more continuous range, their name being Ning. North-west of our camp the Muktschak range was pierced by a ravine, then dry. Between that range and the range which rises on the north bank of the river extends a minor latitudinal valley, from which also a watercourse runs down to the Bogtsang-tsangpo.

On September 30th we followed the open, but by no means broad valley as it gently ascended towards the west-south-west, and we kept so close to the left

bank of the stream that we touched every north-going winding at a tangent. Except at a couple of places only, the volume was always collected into a single channel, which retained its breadth almost unaltered. The banks are everywhere low, and the existing erosion terraces, which rise vertically or with a very steep slope from the water's edge, seldom reach more than one meter above it. The grazing improved, though it was confined to small patches and stretches along the banks. On the other hand, there runs on the left or northern bank of the river an old erosion terrace, which sometimes lies a score of meters or so distant from the existing bank and sometimes approaches so close to it, that there was only just room for the camels to march between the two. The terrace in question consists

Fig. 64. LOOKING WSW FROM CAMP XCIII.

of hard consolidated gravel, has a steep slope, and rises about 4 m. in height. It accompanied us all day, with but few interruptions. There exists a similar terrace on the opposite or right bank, and during the second half of the day's march this terrace was more developed than its *vis-à-vis*. These erosion terraces are memorials of a time when the Bogtsang-tsangpo exercised a far more energetic erosive activity than it does to-day; but the ascent of the latitudinal valley from the river's mouth in the Dagtse-tso is so exceedingly slight that at the present time one can scarcely speak with propriety of any actual erosion. If the lake possesses an absolute altitude of 4544 m., the rise up to Camp XCII (alt. 4623 m.), a distance of

62 km., is only 79 m., and in the next succeeding section of 22 km. it amounted to only 21 m., for Camp XCIII stood at an altitude of 4644 m. In a word the work of erosion is practically completed and the Bogtsang-tsangpo has entered upon a stadium in which the whole of at any rate its lower course serves merely as a through channel for the passage of the water. Hence in this part of the river the water plays in the meantime a passive role, and is no longer able to excavate its bed, that is to say make any change in its vertical depth; the energy of the stream is confined exclusively to horizontal activity, as is evident from the abandoned loops already alluded to.

Fig. 65. LOOKING NORTH FROM CAMP XCIII.

The old marginal terraces are frequently pierced by the outlets of side-glens. As however the steep craggy mountain-ranges that shut in the latitudinal glen on both flanks are rather small in dimensions, most of the side-glens are also quite small. They do indeed manage to break through the terrace, but after that they hardly ever succeed in chiselling a distinguishable channel in the surface. It was only in the second half of the day's march that we passed some of these side-glens possessed of sufficient energy to reach all the way down to the river, and only one of them then contained water. In some places there were small crescentic pools along the banks, filling reaches of the river which have got cut off from it.

The valley runs at first towards the west-south-west, but afterwards inclines to the west-north-west. Sometimes it contracts, then again it widens out; but during the latter part of the day it remained on the whole steadily broader. We forded the stream at the point where it changes its direction and then for a considerable distance travelled along the slopes on the south side of the valley, that is along the top of the terrace. In the throats of the side-glens that open upon the northern bank of the river we counted in all five nomad tents. The conformation of the southern mountains now began to show up more distinctly. It was of course only

in my own immediate neighbourhood that I was able to plot any details; nevertheless I could see distinctly, that there are three ranges, all parallel to one another, and of these the one farthest south is the largest, and forms apparently the water-divide between the Bogtsang-tsangpo and a hydrographical region farther south, probably that of the Dangra-jum-tso and its neighbour lakes. That particular range, glimpses of which we caught at intervals through the openings of the side-glens, though at a considerable distance away, did not appear to have any breach in it; but the glens and watercourses which cut their way through the two parallel ranges to the north all originate in the loftier water-dividing range. It was one of these side-glens that now carried a little water, which no doubt issued from a spring in the vicinity. To these southern mountains our Tibetan escort applied the common name of Nangra.

Fig. 66. THE BOGTSANG-TSANGPO AT CAMP XCIII.

Throughout this part of its course the river is very sinuous, and many of its windings appeared as if they would soon be cut off. The water was in general deep and dark-coloured, and the current was sluggish in the extreme; it was only rarely, when it came to shallow places, that the current was at all lively. In a gap in the nearest range on the north there is a low and convenient pass, giving access to the next latitudinal valley in that direction. Through this breach also we observed fresh mountains farther to the north, probably belonging to the range that borders Littledale's valley on the north.

Our third camp beside the Bogtsang-tsangpo was Camp XCIII (alt. 4644 m.). At that point the river came from the north-west, after making a sweep to the north round a couple of small free-standing ridges. It then makes its way by several sharp windings along the foot of the range that shuts in the valley on the north. Here that range terminated; or rather was broken by a spur, at the foot of which stood a couple of nomad tents. Beside our camp were one or two small

Fig. 67. FISHING AT CAMP XCIII.

elongated pools, evidently former windings of the river. Here the grazing was relatively good. The river was full of fish, and next day, which we devoted to rest, was spent in a profitable fishing, which yielded a welcome change in our bill of fare. Antelopes also were plentiful. In fact, this was one of the pleasantest encampments that we had in the course of our long, monotonous journey to Ladak. The new chief in command of our Tibetan escort, who here placed himself at our disposal, dwelt in the neighbourhood of the Dangra-jum-tso and Scha-jum-tso.

On 1st October the river gave at Camp XCIII the following dimensions — breadth, 15 m.; mean depth, 0.556 m.; mean velocity, 0.512 m.; and volume, 4.27 m.

in the second. A similar measurement made at Camp XCII gave a volume of 4.01 cub.m. Probably the river really does lose volume somewhat along this stretch, because it is not joined by any tributaries; but below the last camp it undoubtedly increases, in consequence of accessions from springs, and possibly from affluents that reach it from the main range in the south.

Fig. 68. FISHING AT CAMP XCIII.

October 2nd. We still continued to travel towards the west-south-west, and during the greater part of the day we had the Bogtsang-tsangpo to the north. Thus here again there occurs a double breach, but this time in the northern range,

for the river then quits its own valley and flows along that which lies to the north. This last latitudinal valley is broad and open, and is bordered on the north by several double series of ranges of moderate or small elevation, and frequently broken; so that through the gaps in the little double range which separates the two latitudinal valleys from one another we often saw three or four sets of similar parallel ranges. By means of the first gap on the right the Bogtsang-tsangpo breaks through from the northern to the southern latitudinal valley. The transverse glen by which it does so is very broad and open, and appears to possess the same exceedingly gentle inclination as the two latitudinal valleys themselves. In fact, it has dropped the characteristics of a transverse glen, being in this respect very different from the last transverse glen that the Bogtsang-tsangpo makes its way through, namely the one which we left not far south-west of the Dagtse-tso. This makes, as we have seen, a sharply outlined and deeply trenched defile or gorge through the southern range. The two little ridges that rose to the west of Camp XCIII were more like the ruins of former mountain-ranges. In the more northerly of the two we discovered a couple of grottoes, which the natives of the locality use as store rooms for keeping fat and salt in. At the foot of the southern ridge stands a tiny butte, rising straight out of the ground, and at its foot some springs bubble up the water of which, beautifully limpid, gathers into little pools. The ground round about them was marshy. The grazing there was in places fairly good. Not far from these springs we crossed over a very flat threshold, which according to my aneroids lay only 11 m. above Camp XCIII, and from it a waterless rivulet runs down towards the river. Next we passed a small lake or large pool, situated at the foot of a red butte. From this point we saw in foreshortened perspective the continuation of the nearest range on the right and at the same time obtained a view of the nearest latitudinal valley to the north, a view that reached a long way to the west. To the north-west, in this same latitudinal valley, we perceived a small lake, and beyond it one suspected the presence of the river. This latitudinal valley is not however identical with Littledale's, but lies south of the latter, as his map plainly shows; for in this region he did not touch the Bogtsang-tsangpo at all, but has pricked out its probable course. It is invariably characteristic of all this part of Tibet, that the mountain-ranges are disposed with an inflexible parallelism from east to west, that they lie pretty close to one another, and do not rise very high above the bottoms of the valleys, but are rather steep and rocky, and consist for the most part of hard rock.

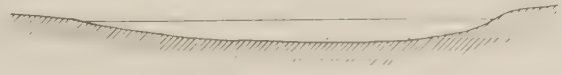


Fig. 69.

Out of a transverse glen on the south came a pretty energetically excavated watercourse, and down it trickled a rivulet, running, at all events where we saw it, towards the north, making for the Bogtsang-tsangpo. Just beyond that a fresh perspective opened out behind us: we were able to see due east down the latitudinal valley that lies south of the most important of the southern ranges which we had seen during the preceding day. The range that now rose nearest to us on

the south contained an abundance of springs: we counted them in five places. One of these, situated pretty high up on the slopes, had given origin to really extensive ice-sheets. It was now a general thing to find all the pools and watercourses frozen of a morning. The temperature dropped during the night to −11°.

Fig. 70. SPRING AT THE MOUNTAIN-FOOT.

After that the ascent became more noticeable and by means of a dry watercourse we ascended to a little soft, rounded threshold in the latitudinal valley, situated at an altitude of 4818 m. To the north of it is a stretch of cliffs, with steep, indeed often with precipitous, faces towards the south. In one place at the foot of the precipice we found a circular walled inclosure; it was a sheepfold in which the nomads protect their sheep at night against the wolves. Immediately west of the pass the grazing was more plentiful than it had been for a long time, and there was also a fresh spring. This inviting spot is called Biri. I decided however to push on to the Bogtsang-tsangpo, the windings of which we saw a long way off in the great latitudinal valley. Accordingly we marched down towards the west-south-west. The latitudinal valley was now framed in by double ranges on both north and south, and of the southern pair at least the one nearest to us was pierced by a transverse glen, which came towards the principal river. Both of the northern pair were breached by the Bogtsang-tsangpo. This at the point where we struck it was flowing north-north-east and north-east, and after that it runs east and south-east. In the northern latitudinal valley we observed yet another small lake, which is undoubtedly connected in some way or other with the river. For, a short distance farther on, we doubled the southern loops of the river before pitching Camp XCIV on its right bank, at an altitude of 4718 m.

This was therefore the fourth time we had encamped beside this river, and I had been able to map the whole of the lower part of its course. Along this

LOOKING E.S.E. FROM CAMP XCIV.

LOOKING S. 4° W. FROM CAMP XCV.

Lustr. A. B. Lagrelius & Westphal.

THE BOGTSANG-TSANGPO.

portion of its length we had found the Bogtsang-tsangpo thus occupying at least three different latitudinal valleys; but its proper channel is in the middle one, up which we travelled; into the other two it only makes short deviations, though to do so it has to break through the ranges which separate the valleys one from the other. We ascertained that it breaks through to the south in order to avoid a pass in its own proper valley; and it is for a precisely similar reason that it bursts through the northern range back again, for at that point we had to cross over a second minor pass in the latitudinal valley.

Fig. 71. EN ROUTE TOWARDS LADAK.

At Camp XCIV the Bogtsang-tsangpo had to some extent altered its appearance. Its current was, it is true, still collected into a deep and very distinctly defined bed; but it was manifestly smaller than it had been lower down. Its breadth was not more than 5 or 6 m., and it is probable also that between Camp XCIII and XCIV it is joined by so many spring-fed rivulets that it perceptibly increases; indeed in that same stretch it appears to receive some actual tributary, for while its water at the former camp was rather muddy, here at Camp XCIV, in the district called Devusang, it was as clear as crystal, so clear that when we stood on the steep banks we were able to see the fish swimming past in shoals. The grass was fairly good; where the banks are held together by grass and roots they overhang in places. The country immediately south of the river is marshy, and appears sometimes to be under water; the ground consists of slippery grey clay, dotted over with gnarled scrub.

On 3rd October we travelled for the last time beside the Bogtsang-tsangpo, fording the river not far from our camp, at a point where it is divided into two branches. Our direction was towards the west-north-west. By this the latitudinal valley had assumed a more irregular form, its attendant mountain-ranges breaking

up into smaller sections. Round one of these sections, situated in the middle of the valley, the river describes a loop towards the south, flowing close in at the foot of the mountain; at its south-eastern corner stood two or three tents. The mountains which inclose the valley on the south are so low and scattered, that we might have travelled south without any especial difficulty.

Fig. 72. EN ROUTE TOWARDS LADAK.

Leaving immediately south of us the section that the Bogtsang-tsangpo encircles, we again struck the river, flowing along a tolerably narrow valley between low ridges, that consisted of the same fine-grained rock as hitherto. In one or two places steep rocks jut out into the river, so that to get the camels past them we had to lead them in the water. After that we travelled along the left or northern escarpment of the river, at the foot of a sharp-edged and irregular crest. In several places we observed traces of encampments. At one spot four big stones were set up on end and propped one against another, the biggest being 1 1/2 m. high; probably they serve to indicate the boundary between two different regions. Just before entering the narrow valley we also passed a sort of boundary of stones, rather small in size, but placed close to one another in a winding line, which appeared to serpentine away in both directions as far as we could see, showing up distinctly against the finer gravel with which the surface was strewn.

The narrow valley through which the river flows, and which is to be regarded merely as a part of the big valley, soon widens again, and in fact swells out into a broad expansion, or rather a spacious plain, with little grazing or none; the ground however was there hard and bore us readily, the only drawback being that it was literally honeycombed with the burrows of the earth-rats, putting me in mind of a worm-eaten tree. The last time we touched the river was where two branches unite, both coming from the south-west. Shortly after that we entirely

lost sight of the Bogtsang-tsangpo, so that it is impossible to determine whether these two branches originate in different regions or whether they are the result of the division higher up the river's course. Littledale, with whose route we again came into contact at this point, appears to entertain the former opinion, for he inserts them on his map as rising, the eastern branch in the south-east and the western branch in the south. This strikes me as being improbable. It is indeed possible that the two streams come from different directions, but their original source must be sought, I opine, on the northern flank of the great mountain-range which towers up beyond the moderately high and less compact ranges that border the plain on the south. That range is, I believe, the westward continuation of the highest of the crests that bound the basin of the lower Bogtsang-tsangpo on the south. In the south-south-west and south-west three snowy peaks were also visible, evidently belonging to the same principal range. I take it, that it is on its northern slopes that the sources of the Bogtsang-tsangpo must be looked for, the river no doubt owing its real origin to headstreams that meet from different directions. Otherwise the view presented in the south-west consisted of a perfect chaos of mountain-ranges and crests, in which the same parallelism as heretofore may be supposed to exist; but their spurs running out in different directions tend to render the whole rather confused. Even from a distance it was easy to see that it would be no easy task to force a way through that country with a camel caravan; though I have no doubt it would not be difficult to penetrate to the forbidden parts of Tibet with a mule caravan. We shall find subsequently that this mountain-system of southern Tibet, which runs on the whole parallel with the Himalaya and the Kwen-lun, continues all the way to Ladak. When I come to the general account of the orography of Tibet, I shall consider the orographical significance of this system as compared with that of the two systems which I have just mentioned, as also with that of the Kara-korum. This vast range, or more correctly speaking this system of parallel ranges, with a dominating main chain in the middle, constitutes a natural bulwark, protecting those parts of southern Tibet and the Brahmaputra valley from which the Tibetans have with such wonderful persistency hitherto excluded Europeans. Here again I had to abstain from carrying out my desire to make an excursion towards the south, partly because of the inaccessible character of the country, partly because of the wretched condition of my caravan. In consequence of this I was again brought into contact with Littledale's route; indeed for a couple of days I actually trod in his footsteps.

We now definitively left the Bogtsang-tsangpo behind us to the south. At the last glance that we obtained of the river its volume was considerably less than it had been before, which points to its receiving a good many spring-fed rivulets in its lower course. After a good long march across the arid, barren plain, we encamped in the district of Rinak-sumdo, at an altitude of 4778 m. There springs bubbled up, giving rise to frozen marshes.

In the narrow valley dense yellowish red limestone cropped out with a dip of 22° towards the S. 30° W., and at the point where we quitted the river the same variety of rock appeared at 64° S. In the latter locality a small range rises a short distance from the left bank of the Bogtsang-tsangpo, the surface sloping gently down from its base

to the stream. At the very foot of the range there is, as the accompanying profile (fig. 73) shows, a very distinct excavation, with a relatively smooth surface, which has subsequently been subject to weathering. This hollow can hardly have been caused by anything else except the beat of waves or some other form of aqueous erosion. The most probable explanation is that it dates from a period when the river flowed at a higher level than it does now, although the difference of elevation between the foot of the rocks and the river's existing level does not amount to more than a few meters. It is also fair to suppose, that this open plain was once the bottom of a lake of the same kind as, for instance, the Addan-tso, and that the lake discharged by an emissary which emerged at the same place as that in which the Bogtsang-tsangpo now enters the narrow part of its valley. The lake will, in that case, have been gradually levelled up in consequence of the progressive erosion of the river, and the filling of its basin by the solid matter brought down by the mountain streams, and in that way it will have disappeared. If that is so, then the excavated hollow at the foot of the rocks will owe its origin to the combined action of waves and ice. The plain at Devusang was perhaps a similar little lakebasin. The extraordinary levelness of these plains, the nature of their soil, namely fine alluvial silt, and the exceedingly gentle upward inclination which the entire region exhibits towards the west — all lend support to the hypothesis, that formerly the Bogtsang-tsangpo flowed through a chain of small lakes, just as the Jagju-rapga flows now through the Addan-tso and the Tschargut-tso and empties itself into the Selling-tso. The only difference is, that the Bogtsang-tsangpo has already accomplished its work and has done its share towards obliterating its lakes. There can be no question that the Addan-tso will eventually be filled up with the sediment brought down by all the turbid streams that drain off the adjacent mountains; but on the other hand the Tschargut-tso will be able to maintain itself for a relatively long period, because the Addan-tso empties itself into that lake in a limpid stream. When from Rinak-sumdo you cast a glance across this extensive arena, you are at once impressed by the idea, that you are standing on the edge of an old lake-basin. Its surface is as level as a floor, the whole of its southern side is still occupied with marshes, and it is encircled by a ring of mountains, the only breach in which exists in the east, namely that by which the river makes its exit. To the west-south-west rises the dominating ridge which Littledale calls »Tongo Volcano 4000' above camp 102»; though I was told its name is Erenak-tschimo. The snowy mountains to the south are said to be called Gangi-gamo and those to the north Jagnak.

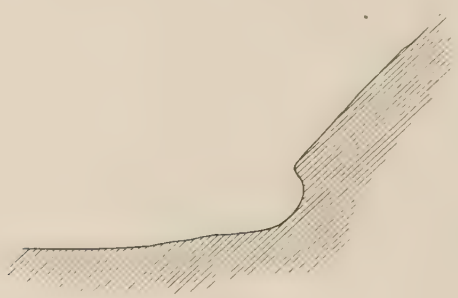


Fig. 73.

The especially fine weather which we had for several days enjoyed now came to an end, and was succeeded by coolness and westerly winds, accompanied by several good hail showers, some of the mountainous parts being sprinkled all over white after them.

LOOKING N° 44° W. FROM CAMP XCV.

LOOKING S. 76° W. FROM CAMP XCV.

CHAPTER IX.

FROM MT ERENAK-TSCHIMO TO MT SCHA-GANDSCHUM.

October 4th. We had no alternative except to follow the only practicable route towards the west, namely the same route that Littledale travelled by, and even that was difficult enough for our camels. I myself however made an excursion up the slopes of the mountain which Littledale mistakenly supposed to be a volcano. On the way up I observed, first some bosses of red conglomerate and sandstone, as well as two large watercourses, both containing tiny brooks fed by springs. On the bank of the second stands an *obo* of *mane* slabs, probably intended to proclaim the fact that the mountain is regarded as holy. Just above it a pointed rocky crag rises directly out of the ground and west of it stood a tent, though we perceived no human beings about it. I dare say they had purposely hidden themselves or had been commanded by our escort to disappear, so as to avoid supplying us with a guide who might show us a more southerly road. But from what we subsequently saw of the country in that direction, the more northerly route that we adopted was in point of fact the most convenient. Perhaps however the sanctity of the mountain may have been considered sufficiently great to keep Europeans at a distance from it.

Leaving the obo we rode south-west up a side-ravine, which, like so many of its neighbours in the flanks of the mountain, unites with the more distant of the two glens down which the rivulets were flowing. This one came from the west-north-west, and turned to the south-east, and south-south-east, evidently with the intention of emptying into some marsh or lake in the big arena-like plain. From the very first the ascent up the ravine was very steep, in fact we were able to keep to our horses for only about two hundred meters up. The ravine appeared to terminate at an abrupt precipitous wall, where the hard rock cropped out as a bare and naked wall. After leaving our horses in a fissure of the rock, we continued the ascent on foot; but we were not able to take many consecutive steps at once owing to the great altitude, for we were considerably above 5000 m. We were unable to reach the foot of the precipice, where a vast avalanche of stones would seem to have fallen some time or other. On the way up we observed hard rock in certain places. From the point where we stopped, we obtained a magnificent view of all the region we had travelled through ever since leaving Dagtse-tso. The

highest mountains in that locality were the three snowy summits to the north of that lake. Between them and the Erenak-tschimo intervenes a veritable ocean of mountain-ranges, peaks, detached buttes, and valleys, and it was only with the help of the compass that I was able to conjecture the route which our caravan had

Fig. 74. VIEWS FROM THE HIGHEST POINT REACHED UPON THE ERENAK-TSCHIMO.

followed. Even the valley of the Bogtsang-tsangpo did not stand out in any way conspicuously, not more noticeably in fact than its nearest neighbours; nor were there any other dominant features in the landscape. It was nothing but an indistinguishable tangle of mountain-ranges, amongst which our route was quite lost.

One thing you do however learn from a general view like this: namely you learn more distinctly than in any other way how insignificant a single exploring itinerary is amongst such a boundless and little known mountainous country. How often do we not see the statement made, that we are now fairly well acquainted with the geography of Tibet. For my part, I should prefer to say, that we possess merely a glimmering of the broad, main features of the physical geography of the country; but we cannot boast, that we possess even the rudest reconnaissance map of the *whole* of Tibet. The routes of the travellers — painfully few! — which cross the country in different directions embrace between them a very small percentage of its area, and there still remains an inconceivably vast amount of work to be done in this respect.

Fig. 75. OBO AT THE FOOT OF ERENAK-TSCHIMO.

When viewed from our higher point of vantage the plain of Rinak-sumdo gave in a still higher degree than before the impression of being a desiccated lake-basin, and it was from there that we first obtained a distinct general view of the many small lakes and marshes which occupy the whole of its southern side, and almost give the impression of being the last survivors of a single large lake, which has shared the fate of so many other Tibetan lake-basins and has disappeared. In the south-east there stood out a fantastic, snow-clad mountain-mass, belonging to the main range which we had had pretty close to us on the south ever since leaving the region of Naktsong-tso. To the north and north-east, that is in the country we were about to traverse, rose a whole series of smaller mountain crests, with pinnacled, serrated forms, putting one in mind of crenelated, fortified walls. Amongst them one detached rocky pinnacle was especially conspicuous, by rising like a gigantic pillar out of the disintegration material. A few hundred meters higher up some smaller patches of snow were still remaining.

After we got back to the obo, we directed our steps towards the north-west, crossing on our way over three of the denticulated crests which I have mentioned. The first has a very inconsiderable pass; while the other two are pierced by the more easterly of the two glens down which brooks were flowing. Beside the rivulet

Fig. 76. VIEWS FROM BETWEEN THE ERENAK-TSCHIMO AND THE PASS.

were three nomad tents, and from our outlook above we had seen three others standing on the plain at the south-east foot of the mountain. In the bifurcation of the third crest, on the right bank of the stream, there is a grotto, consisting of two divisions, an outer and an inner, and separated from one another by a wall of re-

Ljustr. A. B. Lagrelius & Westphal.

MOUNTAIN RIDGES NORTH OF THE ERENAK-TSCHIMO.

gularly shaped slabs, with an opening in the middle. The entrance to the grotto is about 3 m. high. Standing in its interior, in the deep cool shade, we had a peculiar and enchanting view of the mountainous country to the east, then bathed in sunshine. That this grotto had long been used as a human habitation was manifest from the thick coating of soot which clung to its roof and walls, betraying that the fires had been made of yak-dung or sheep-dung. Indeed there was some of the last named still heaped up inside the grotto; from this we may also infer that shepherds sometimes use the grotto as a night-shelter for their flocks in winter. But the numerous slabs, with the usual formula of prayer engraven on them, that were lying on ledges and cornices of rock all over the inside of the grotto pointed

Fig. 77. THE ERENAK-TSCHIMO AS SEEN FROM THE PASS.

to its apparently being used for religious purposes. Possibly some hermit or lama, having dedicated his life to the service of the deities of the mountain, may have had his domicile here. The discovery of the sacred slabs at these two places, the obo and the grotto, are an unmistakable proof, that the mountain is regarded as holy. The obo was not, it is true, of any great size; but it was nevertheless erected with a certain amount of care. It consisted of a square pediment, with a big stone placed on edge on the middle of it, while several slabs, all inscribed with the prayer formula, were arranged round it as if placed on a table. The slabs were made of marble, green schist, and red sandstone. Nor is it surprising, that a people, addicted as the Tibetans are to belief in nature gods, should be induced by the peculiar features of this particular region to consider that it is in intimate connection with their deities. Even by its very appearance alone, towering up as it does amongst the clouds, and visible as it is from every direction, the Erenak-tschimo produces an especially striking effect upon the mind. And then there are the little crests, with their strange outlines, resembling fortress walls, erected by

the gods for the protection of their holy mountain. The third of these jagged crests, lying farthest towards the north, produces a very curious effect upon the beholder, for its southern face is almost perpendicular.

Leaving the grotto, we rode up the glen towards the pass from which the glen-stream descends. This pass, at an altitude of 5014 m., is ensconced in a not inconsiderable range, the southern side of which is seamed by several similar glens, some joining the one we were travelling up, others piercing the three crenelated crests each by its own independent glen, but all alike making for the »threshold» on the south of Rinak-sumdo. On the pass, which was easy and comfortable, we found an obo without any *mane* stones, but with coloured streamers of cloth, tied to strings and fluttering in the wind. As we came across no other votive objects after this, the range in which the pass is situated would appear to be regarded as he northern boundary of the sacred region.

Fig. 78. LOOKING NE FROM THE PASS.

From the pass we descended towards the north-west by a side-glen, that slopes very gently down towards the latitudinal valley in which we were about to travel for a considerable time towards the west. Immediately on our left we had the rounded spurs that jut out from the northern face of the boundary range, and on the right a steeper and more accentuated cliff belonging to an offshoot of the same range. The rivulets of the locality gather into a main watercourse, with a brook flowing down it on the west or left side of the valley, and having marshes strung along it at intervals. At the junction of side-glen and main valley we formed Camp XCVI, on the right bank of the river Tschuring, which comes from the west and at that point bends to the north-east, keeping close in under the foot of the mountains on the north side of the valley. At that season the quantity of water in the river was very small, barely a cubic meter, almost the whole of it spring-

water, cold and as bright as crystal. It contained fish, and in some places there were wild-duck. At this part I should have known that I was on Littledale's route even though I had not had his map before me; for not only did one of my men, Mollah Schah, who had also accompanied Littledale, recognise the country again, but we also picked up an ass's shoe, an object that can hardly have been left except by Littledale's caravan.

The rocks we observed during that day's march were as follows: a red conglomerate, dipping 80° towards the S. 40° W., not far from Rinak-sumdo; on the right of our route we saw several similar small bosses and ridges, in which however the strata appeared to dip 30° to 45° towards the N. and NE.; in a small detached knob near the first obo was the usual fine-grained rock, dipping 78° S. Next in the steep gully by which we climbed up Erenak-tschimo, amongst hard rock, we perceived a hard resonant greenstone, dipping 64° W. Higher up it occurred again, though not very generally, in the form of gravel in the bed of the river, while at its sides this sharp-edged detritus gravel was in places piled or built up as it were into sharply defined terraces either by running water or by avalanches of snow. A few meters farther up in the same ravine or watercourse there cropped out a light red granite, hard and fine-grained, and tilted 76° towards the N. 5° W.; and not very far above that was a hard crystalline rock, dipping 77° towards the N. 33° E. Besides these I collected various other specimens of rock, which, though they only occurred in the loose gravel, tend at any rate to show that this mountain is of fairly complex composition. Amongst these is a white marble, which occurred not only in fragments of great freshness and wonderful beauty, but also in pieces that are yellowed, brittle, and cracked. This I nowhere discovered as »living» rock: there had been a knoll of it on the right side of the glen, but that is now completely weathered away and destroyed. Further a light-coloured crystalline schist and a black rock, probably diorite or diabase, of which there were only a few fragments higher up in the glen, pointed to the fact that somewhere the mountain must be traversed by veins of these rocks. After that came a white crystalline variety, mottled with some sort of mineral matter; then a friable yellow rock, which put me in mind of pumice. We only found one single specimen of porphyry in the lower part of the glen; it consisted of a hard, dark-green, resonant variety. The little crest with the grotto described above consisted of limestone, dipping 72° towards the S. 15° E., and this same rock appeared to prevail in all the small ranges which stretch with such remarkable regularity east and west in parallel chains, thus bearing no slight resemblance to the mountains on the shores of the Tschargut-tso. In places they may indeed reach an altitude of 200 m., but generally they are much lower. With regard to all the detached fragments that I have just mentioned, it is of course fair to infer that their provenance was in hard rock higher up, probably for the most part in the steep precipice from which the stream

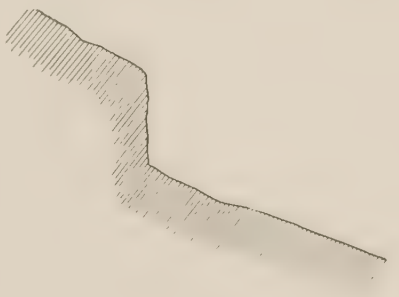


Fig 79.

takes its origin, and which when seen in profile has something of the appearance shown in the accompanying sketch (fig. 79). Nevertheless the mountain in question is not a volcano, nor does it bear the slightest resemblance to a volcanic cone. When seen from the east, as Littledale beheld it, or from our Camp XCV, whence we perceived it to the S. 76° W., it does, I grant, look like a single crest; but it is then viewed in foreshortened perspective, its eastern fork only being visible. When seen however from the pass with the streamers, it clearly shows a not inconsiderable extension east and west, and consequently runs parallel to every other chain in that locality. From its neighbours it is distinguished by its very considerable altitude, in that it towers up like a veritable giant above the chaos of mountains around it.

October 5th. Although the cold was not *per se* especially severe, yet taken in conjunction with the inconceivably violent wind which was then blowing from the west, and consequently driving straight in our faces, it made in that regard about the utmost limit of what a man can bear. And yet the sun shone out almost all day long: it was only at two o'clock that the sky was somewhat clouded. But the wind completely neutralized the sunshine, the effects of which are sometimes so great, even in winter, that the skin sloughs off your face every second or third day. Not one drop of either rain or hail or snow fell. Even the Tibetans of our escort found the weather too keen for them to ride; they too got off and walked. But walking also is extremely trying; I for my part was unable to walk in that rarefied atmosphere and violent wind. The method that I adopted was to keep my saddle until my fingers refused to render service, and then to get off and rest in the shelter of some buttress or in a ravine, until the circulation was restored. In fact under such conditions I can readily understand how it is not difficult for a man to freeze to death: you get numbed, become insensible to feeling, and without suspecting it you drop off to sleep and never waken again.

During the night the stream froze at our camp, and in the morning in the quiet reaches it was completely frozen over. In some places the ice-sheets got adrift and became subsequently heaped up after the fashion of *torosses*, or the piled up bergs, of the (Siberian) Arctic Ocean. A flock of wild geese, which had settled in the vicinity of our camp, were probably on their way south; for it is safe to say, that these birds would fail to find sustenance in Tibet in winter after all the fresh-water surfaces have become frozen. From our camp the river Tschuring flowed at first towards the north-east, though it keeps that direction for only a short distance. The Tibetans declared, that farther on it joins the Bogtsang-tsangpo, and the statement is very likely true. Littledale however shows it on his map flowing definitely towards the north-east. The river is forced to adopt its north-easterly course by the steep precipice, already mentioned, which forms a northern outlier of the range that we crossed over the day before. All day long we had this range rising like a vertical wall on the east side of the latitudinal valley; but in point of fact the precipice would appear to make the river describe an angle only, after which I have no doubt it resumes its east-west direction. Finally it breaks through the range which we had on the south by one of the gaps that we had seen in it farther east, and so effects a confluence with the other stream.

From Camp XCVI, which stood at an altitude of 4947 m., we ascended slowly towards the west, keeping at first close to the southern bank of the river. Out of the mountains on the south issue several inconsiderable transverse glens; but of these only one or two were shaped into watercourses that reach all the way down to the Tschuring. Beside one of these there were a couple of sheepfolds in the shape of circular walls, open towards the east, wherein we may discern a reference to the westerly wind which prevails there so persistently. The grey walls contrasted sharply against the almost black ground of the interior — a thick layer of sheep-droppings. The valley is broad and open, the surface in its middle only slightly undulating. The range that shuts it in on the south is fairly imposing, but exhibits rounded outlines; whereas the range on the north is of smaller dimensions, though occasionally rising into loftier summits. Towards the west it decreases in altitude and is broken by gaps, and finally dwindles away altogether. One can hardly speak of grazing in that region; we saw neither yurts, nor flocks, nor wild animals. The country is dead, cold, desolate; while the wind wails through the latitudinal valleys, which stretch like weird organ-pipes directly in its path.

We again came into contact with the river in the vicinity of a very small lake, where the current hugs the foot of a minor spur of the northern range. Here we crossed one of its windings, and then again drew away from its bank, striking diagonally across the valley towards a small isolated mountain-mass with a little crescentic lake at its western foot. The country between the northern range and this mountain-mass is said to be marshy, rendering it impassable. From our route we were unable to make out whether the Tschuring flows through the little lake or not; possibly the latter should be regarded as merely a fluvial marginal lake. After that we steered towards the west-north-west, keeping close to the foot of the mountains on the southern side of the valley; there too we came across several small sheets of water. After that the valley widens out, expanding towards the north into an extensive plain. We passed only one field of grass, with flocks of sheep and herds of yaks all round it. Through the gaps which occasionally opened in the southern range we caught glimpses, at no great distance away, of a rather big crest of precisely the same character as the Erenak-tschimo, clearly its westward continuation; in some places it bore patches of snow. Out of certain of the transverse glens on that side issue small spring-fed rivulets. At Camp XCVII in a locality called Setscha or Ri-setscha, we were again at an elevation of 5048 m., our camp being formed on the bank of the Tschuring. The scanty pasture was wretched in the extreme.

At the point where we forded the river the rock consisted of a very hard greenstone, dipping 58° towards the N. 67° W.; and at the little butte a similar rock cropped out, though it bore a closer resemblance to porphyry and dipped 75° to the S. 53° W.

On 6th October we covered only a few kilometers, until we reached a locality in which the Tibetans promised us better grazing. And it was high time we did get a little rest, for half the caravan, men as well animals, were ill and exhausted by fatigue. After that our heavy baggage was carried by a score of yaks. The weather was the same as on the day before — sunshine, cold, and hard wind from

the west. The river, which was here divided into several shallow, superficial arms, was frozen hard in the morning, there having been — 14·9° frost during the night; thus we were able to cross it dry-shod. In consequence of being frozen the river had in some places spread itself out, giving rise to small floods; hence during the course of the winter ice-sheets similar to those that are formed below the mountain springs will pretty certainly arise here. We pitched Camp XCVIII at an altitude of 4998 m., beside a little clay hill not far from the foot of the mountains and in the vicinity of an open spring-fed basin. The promised grazing was however in point of fact just as wretched there as anywhere else; but we were now promised, that we should indeed find better after a long day's march to the west beside the river Dungtsang-tsangpo. However I had no opportunity to visit that river, for upon striking camp again, I preferred to adopt a more southerly route; but the caravan followed the main valley, treading in Littledale's footsteps, a thing I was anxious to avoid doing myself. Littledale's map shows however that a river bearing that name actually does exist; he calls it Dunzan-sanpo, and it seems to flow towards the west.

After ordering the caravan to wait for me somewhere in the neighbourhood of the mountain-mass of Scha-gandschum, I set off on 7th October with five horses, four mules, and four men towards the south, intending to cross over the nearest range and make a reconnaissance on the other side of it. As I undertook this little excursion directly contrary to the desire of my Tibetan escort, I had of course to go without a guide. Nevertheless if the country in that quarter did not prove too unfavourable, we should, I expected, be able to find our way to the rendezvous by ourselves. The simplest plan would have been to follow the river Tschuring from Camp XCVII, travelling up the easy glen through which it makes its way from the other side of the southern mountains into the latitudinal valley. But as I felt satisfied, that by crossing over the most northerly of the parallel ranges I should obtain a more extensive orographical view, I preferred to start from Camp XCVIII, and to travel south-south-west through the nearest transverse glen, which ascends fairly gently towards an easy, rounded pass. The slope on the south is much steeper and descends directly to the valley of the Tschuring, which is in general rather narrow, though without contracting into any really strait passages. In the occasional expansions of the valley the pasture was better than it had been for a long time. In one of these expansions sheep, yaks, and horses were grazing round a tent. The river flows sometimes in a single collected channel and sometimes it is divided into several arms. The southern range, which forms the direct westward continuation of that which we had crossed over by the obo pass, is more massive than that on the north, and is pierced by steep transverse glens opening upon the principal valley of the Tschuring. The greatest of these bore south-south-east from the pass; but like all its fellows, it carried no rivulet. To the south-south-west appeared a shoulder of the more imposing range from behind which the river emerges on its way from the south, though it soon turns towards the north-east and east-north-east. The bottom of the valley sloped gently towards Camp XCVII; in a few places however, as for instance on the left side, where a buttress projects, contracting it, the fall is so far appreciable that small rapids are formed. In quiet reaches the river was frozen; its waters abounded in fish.

Its banks were lined with belts of scrub and yellow grass, as hard as wood. The river-bed is generally stony and shallow, and the water was perfectly transparent, though the volume hardly amounted to 1 cub.-m. in the second. After turning the mountain buttress just mentioned, we travelled S. 60° W. and then passed a couple of tents. Upon reaching the next bend in the valley, where it bends almost due south, we halted (Camp XCIX at an alt. of 5094 m.) in a crevice of the mountains, where the grazing was good. Except for a cold south-westerly wind the weather was favourable.

On the 8th October we again did quite a short stage, as far as the lakes out of which the river Tschuring issues. The night before was keenly bright and stinging cold, and a gentle descending current of air was the only atmospheric movement we were able to detect. In the morning the river was everywhere frozen so hard, even in relatively swift parts of the current, that the ice bore. After crossing over it twice, we kept subsequently to the right bank. The valley is rather narrow, runs first south, then south-south-east and south-east, and then gradually widens out into the arena-like expansion that contains its gathering basin. There the grazing was good. In the south appeared, at a distance of about 10 km., a larger range, which, I suppose, is the true water-divide of the region; the water that flows down off its southern flanks makes its way to parts of Tibet which are only known from the accounts of Nain Singh. This range was in places covered with snow. The valley of the Tschuring is met by another valley coming directly from the south, though without a watercourse. In the angle formed by the two valleys there rises an almost free-standing butte, with a lake at its north-eastern foot barely half a kilometer long, through which the river flows. When we put up our tents at Camp C on its northern side at noon, it was still covered from end to end with a thin sheet of ice; but shortly afterwards, when the wind began to blow, the ice broke up. Both the shape of the valley floor and the changes of colour in the lake betrayed that the lake must be very shallow. It did not appear to contain any fish, at all events we saw none near the shore, though we did observe a few wild-duck. On the east side of the lake is a tiny pool, and beyond that yet another small round lake, likewise traversed by the Tschuring. East of this second lake comes a flat pass, the true water-divide of the Tschuring. The actual headwater stream issues however out of a transverse glen in the southern range and flows through the two lakes. At first therefore the river runs towards the west, then it swings round through the mountains until it assumes an easterly direction, piercing on the way the range which we crossed over by the obo pass. From the neighbourhood of these lakes we perceived a distinct path leading towards the south-east, and crossing by some easy pass to valleys farther south, in which the nomads will pretty certainly be more numerous than they were in the localities through which we were then travelling, for in the neighbourhood of our Camps XCIX and C we counted in all only four nomads' tents, with but a few inhabitants in them.

The small freshwater lakes would now certainly be frozen in the course of a few days. A rather well-marked strand-rampart runs now close to, now at a greater distance from the existing beach-line of the larger lake, pointing not only to the occurrence sometimes of a higher level, but also to the possibility of its having

been formed by the action of the ice. At this particular season of the year all the water both of the lakes and of the river is derived from springs, several of which discharge into the lake on the south. This uniform inflow accounts for the constant volume of the river, which is entirely unaffected by the time of day at the season in which the melting of the snows is practically quite neutralized. The name given to this lake by our Tibetan guards was Dschandin-tso, while they called the country around Camp XCIX Somdü-dschalün-tsagma, the mountains to the south Nemba, and the nearest range on the north Sendo; though it is of course impossible to say how far this information is reliable. In the last-mentioned range there occurred schists, in part black and soft, like graphite, in part hard and finely crystalline. On the whole the country impressed me pleasantly and sympathetically. I learnt from this little excursion to the lakes that the sources of the Tschuring lie much nearer to the great latitudinal valley than I had imagined they do. The river cuts its way through only *one* range.

Fig. 80. CAMPING.

On 9th October the little lake was again covered with a thin sheet of ice. We were still accompanied by the everlasting westerly wind, and no matter whether we travelled north-west or south-west, it always blew straight in our faces. The sky was of perfect serenity, not a speck of cloud to mar its purity. After leaving the lake we travelled west, crossing the river and doubling the almost free-standing mountain buttress, and then entered the throat of the broad glen which the day before we had seen due south. This glen comes from another arena-like valley expansion, upon which other glens converge from every direction. Leaving that expansion to the south, we ascended the slowly rising valley that approaches from the west-south-west. This cauldron-shaped valley is marked by one unusual feature, in that a very small free-standing butte rises in the middle of it. To right and to left of

Ljustr. A. B. Lagrelius & Westphal.

TIBETAN CAVALRY.

it stretch expanses of blue water, evidently both belonging to the same little lake, which is said to be called Schaggelang-tso. South of this lake, at the distance of about 15 km. from our route, runs an east-west mountain-range, which appeared to be exceptionally low. In colour it is very dark, in shape rounded, and has steep slopes. Its crest was tipped with snow. Beyond it I failed to detect any other ranges, nor did I observe any conspicuous peaks. Between the route we were following, close to the southern foot of the range that is pierced by the Tschuring and the butte that rises on the northern shore of the lake stretches a very flat and barren plain. The valley we were marching up towards the west-south-west is inclosed between rather rocky, fantastically shaped mountain-spurs, and is traversed by a broad, fairly well defined eroded watercourse, which enters the Schaggelang-tso. For some distance our glen was rather narrow, but eventually it too opens out, and we again had to choose between three glens that debouch upon it. The one to the south seemed however to be soon stopped by the main range on that side; the second runs towards the south-west, has a detached rocky butte in the middle, and no doubt is also stopped by the main range, both glens apparently starting at its crest. The third glen swings away towards the west-north-west, leading up to a pass; this was the route we selected, leaving on our right, as we proceeded, a projecting spur, with a sharp and denticulated crest. Just underneath the pass, in its eastern gathering-trough, the ground was wet from springs, and they gave rise to a little brook, which however soon died away. The pass is rounded and easy, and the acclivity leading up to it is not at all steep; in fact it is only a threshold in the latitudinal valley. Yet in consequence of the considerable altitude above sea-level, every ascent in these regions cost our caravan-animals the most strenuous exertions. The view to the west from the little pass, which had hitherto acted as a screen, was magnificent. Far away to the S. 89° W. we beheld the majestic mass of the Schah-gandschum, clothed from base to summit with perpetual snow, and forming three separate humps, a big one in the middle and a smaller one on each side. In the clear, pure atmosphere and vivid sunshine, the mountain presented a splendid appearance, causing all the details and contours to stand out with extraordinary vividness. The range on the south side of the latitudinal valley, with its great craggy knots, continued to be steep, fantastic, and gloomy. The northern range is more rounded in outline.

The western declivity of the pass is far steeper and longer than that on the east side. The eroded watercourse that runs down it terminates in a brook, which flows at first to the N. 12° E., but afterwards trends towards the north-north-west, clearly forming a transverse glen that debouches upon the big latitudinal valley in which stood our Camp XCVIII. The grazing was as usual wretched; all the same we observed a herd of wild yaks down in the glen. The latitudinal valley which we had hitherto followed continues towards the west-north-west, being merely divided by the threshold upon which we were standing. We formed Camp CI on the bank of the stream, the sources of which were not far distant, being situated on the northern slope of the southern range. The region is one of majestic and imposing beauty. Around our camp the bottom of the valley was relatively broad and level, and the ground water-logged. There again the river is joined by several small brooks. The altitude was 5241 m. This district is called, I was informed, Amrik-va.

We saw kulans and orongo antelopes, and the burrows of the marmots were not uncommon, although none of the animals showed themselves; possibly they had already begun their winter sleep.

October 10th. The sky still continued to be pure and of a perfect turquoise blue, while the wind blew hard from the north-west, this direction being, I dare say, in great part prescribed by the direction of the valley. These meteorological conditions continued to be persistently characteristic of the late autumn, setting in after the summer, and being followed by the rains of early autumn. I was astonished to find the atmosphere so bright and transparent whilst a violent wind was blowing, but the explanation is no doubt to be sought in the fact that the greater part of the fine disintegrated material was being held fast, first by the moisture after the rains and then by the frost.

Fig. 81.

We continued along the latitudinal valley until we came to a small threshold, which again serves as an important water-divide, for there is a fresh gathering-basin on its western side. This basin is drained by a stream which flows north-north-east, breaking through the range which we had immediately on our right, that is to the north. This gathering-basin is bounded on the west by yet another little threshold. Thus our route now ran through a rather narrow latitudinal valley, bordered on the south by an imposing and fantastic rocky crest, touched occasionally with snow, while the range on the north is less rugged, though pierced in one or two places by the brooks that flow down off the southern range. It was precisely the same orographical architecture that we so often encountered on the Arka-tagh, and also in the Astin-tagh whilst travelling between Temirlik and Anambar-ula. In point of structure the latitudinal valley which we were then following is remarkably symmetrical, forming a curve, concave towards the north. At neither extremity of it, to east or west, is the range that borders it on the north broken by transverse glens; instead of that the water gathers off the mountains on both sides and forms main streams, which follow faithfully the general direction of the valley. In the middle, where the latitudinal valley is highest, it is crossed diagonally by two watercourses, which carve a path for themselves through the northern range. Consequently they flow at right angles to the streams which run east and west down the valley. The main features of the morphology of the region are represented in the accompanying sketch (fig. 81).

After having crossed over the third pass, we followed a dry watercourse, which clings to the right-hand side of the valley, and ere long unites with its principal drainage artery, a brook partly with an active current, partly frozen, which issues out of a transverse glen in the main southern range. It picks up subsequently several tributaries, some containing water, others dry, and most of them of course draining off the southern range. Some of these channels contained nothing but strips of ice or ice-sheets frozen to the bottom, without a single drop of water. On the left we had close at hand a great swelling of the southern range, dominated by a conspicuous snow-capped peak. We saw here wolves and tame yaks, but the grazing was still extremely poor. The valley has a gentle slope, and continues to trend more

and more towards the north-west. At the same time it increases in breadth. At length the surface becomes practically level, and would have been first-rate for riding on had it not been so honeycombed with the burrows of the earth-rats. The principal drainage-artery of the valley is broad and sharply outlined, but its lower part was then perfectly dry. It clings faithfully to the foot of the northern range. I add (fig. 82) a transverse section showing its position. In front of us, to the west-north-west, rose in the middle of the big latitudinal valley a smaller, though double butte, with steep sides. At its eastern base there is a level expanse of yellow sediment, which after copious rain is converted into a small round lake, fed by affluents from the adjacent mountains. On its margin stood five tents, and not far away some pretty big flocks of sheep were grazing, although it is a mystery to me how the animals support life in a region which is so poor in pasturage as that is; besides, the wolves are dangerous. In an angle at a breach in the northern range lies a little lake, and to the north of it a *thalweg* is stated to lead to Dungtsang-tsangpo. Hence I suppose that a minor threshold separates the little lake from the transverse glen which runs north.

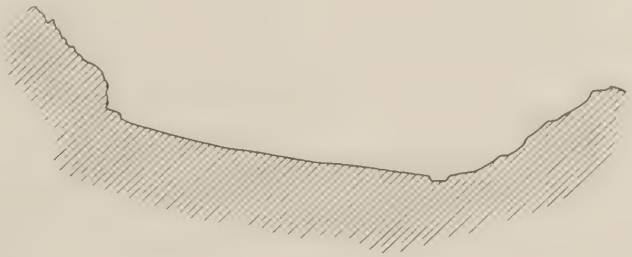


Fig. 82.

From the top of the little mountain at Camp CII (alt. 4903 m.), the eastern foot of which is grazed by a deep-cut ravine, we saw to the north-west a chaos of mountains; these we were to thread our way through during the immediately following days. On the other hand the greater part of the Scha-gandschum was screened by a spur of the southern range. All we could see was the rounded, snow-capped summits, and the vast swelling appeared to continue towards the west in the shape of a range of moderate dimensions, on which there was no great quantity of snow. On the higher parts we failed to detect any glacier arms; it was only here and there that the snow gleamed out in patches like polished metal, an indication that it was in process of melting, and certain sombre projecting rocky portions appeared to be still wet. Generally however the snow was dry and whirled up in clouds when the wind blew. Between the Scha-gandschum and the range which we had last on the south a considerable latitudinal valley runs towards the west. To the south-east we had an especially beautiful and attractive prospect of the latitudinal valley up which we had just travelled.

Near the first threshold that we crossed over dense, grey limestone cropped out with a dip of 53° N., and in the little mountain at Camp CII the same rock dipped 78° towards the N. 34° E. In fact, in that region this rock prevails everywhere.

The country around Camp CII is said to be called Dschanok and the little lake Urtschang-tso.

On 11th October we left this place, the wind blowing as usual obstinately from the west. The surface inclines generally towards the same direction and towards the north, and is level and first-rate for marching on. The only fresh water was in the lake, which possibly possesses an outlet towards the north. On our left we had two small free-standing buttes, and shortly after that a third, still smaller; while on the right was a stretch of fairly low heights. After that we emerged upon an extensive open, level plain, and all at once acquired a magnificent view of the imposing mass of the Scha-gandschum, which appeared to spring directly from the south

Fig. 83. RE-SHOEING THE HORSES.

side of the plain. It was a mortification to me that, in consequence of the lateness of the season and the exhausted condition of my caravan animals, I was prevented from minutely exploring this mountain and unravelling its connection with the adjacent mountain-ranges. Its base can be approached without difficulty from both east and north, and I have no doubt that here, between the Scha-gandschum and the western end of the range which we had last had on the south, a convenient route could be found, leading into the more southern parts of Tibet; for if there does exist a pass to the east of the mountain, it must be flat and easy. Our Tibetans maintained of course that it was impossible to penetrate south from that region. It now became distinctly apparent also, that north of the mountain and south of the range beside the recently mentioned latitudinal valley there stretches another latitudinal valley, parallel with that which we had last travelled up. The correctness of the name Scha-gandschum is rendered the more probable in that the name occurs also on Littledale's map, although he spells the word Shahkanjam. At this part his route runs north of mine, that is in a more northerly latitudinal valley. Some of the Tibetans called

the mountain Tugdschar, though this applies, I have no doubt, to some other locality in the vicinity.

On the Scha-gandschum certain details now became noticeable, which we had not perceived before. The great snowy mass resembles in shape a gigantic animal *couchant*, with a sharply sculptured, arched back. Its summit is crowned by certain more conspicuous peaks, and it possesses very well-marked, rugged flanks; but the culminating summit, the very highest eminence, rises but little above the adjacent parts of the »back». Immediately west of the Scha-gandschum there is a gap in the range to which its great mass belongs, and there too there exists, I dare say, a convenient pass. West of that gap the range is less compact and less regular in its construction, for it sends out spurs and offshoots to the north. The strips of snow which impart to the range a streaky appearance are certainly not derived from perpetual snow; that range is, I have no doubt, free from snow during the greater part of the summer. On the other hand, the white mantle that clothes the whole of the principal mountain-mass is perpetual snow, and through it the black cliffs project at the steep places. From the main body of the mountain several fairly short spurs and offshoots reach out north and east, rounded in outline and in part covered with snow. The farther we advanced towards the west, the more evident it became, that ice-formations were not altogether absent on this mountain, for on its western flank we made out four distinct, though extremely short and rudimentary, glacier arms, which stream down by so many separate hollows from their common dome-shaped *firn* origin. They were all covered with snow; but we were able to make out distinctly their side-fissures, and also their terminal moraines.

On our right we perceived a gap in the northern range, and towards it runs a broad glen-opening that starts in the southern range. One of the Cossacks, whom I sent up to it to reconnoitre, declared, that it was a transverse glen cutting right through the range. After that we frequently crossed over very broad and shallow gravelly beds, in which were one or two very thin and brittle ice-sheets. These channels were evidently of the kind that only carry water after heavy rain or snow, but then swell to a considerable volume; though they drop again as swiftly as they rise.

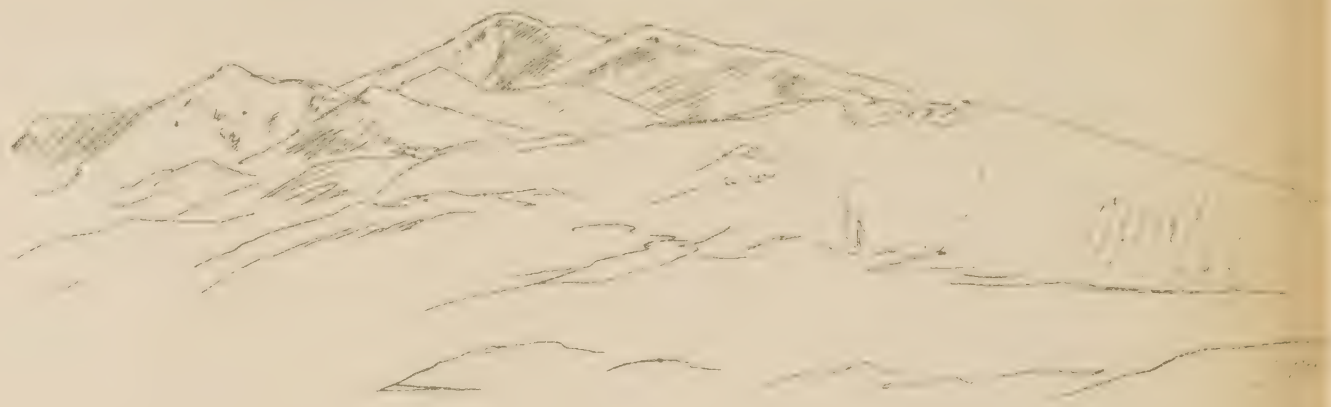
After marching round yet another and relatively low portion of the northern range, which however consists for the most part of bare disintegrated crags, we reached a big watercourse embraced between steep escarpments, which cuts its way through the northern range in a rather narrow gorge in a north-westerly direction. The mountains which inclose this gorge or glen are however so slight that they hardly deserve to be called anything more than hills. At that time there was neither water nor ice in the bottom of the watercourse; but its energetic modelling warrants the conclusion, that in summer, after rain and when the snow is thawing fast, it must serve for the passage of considerable volumes of water. At only one spot in its bed did I observe a tiny spring trickling out; but the rivulet soon died away amongst the gravel. Shortly afterwards this watercourse is joined by a second similar watercourse, which likewise issues out of a transverse glen. Thus between the two glens lies a perfectly detached portion of the northern range.

It was not far below this point that we again fell in with the caravan, encamped in an expansion of the valley, amongst marshes and numerous springs, and

with relatively good grazing. These spring rivulets gradually give rise to a brook, which carried, I dare say, about half a cub.m. of water in the second; but all the same abounded in fish, though these were only of small size. They were disporting themselves chiefly in the lagoon-like expansions of the brook, under the overhanging eaves of the grassy margins. Camp CIII had an altitude of 4775 m. It was from it that I took the accompanying sketch (see one of the panorama Plates) of the Schagandschum as seen in foreshortened perspective. That region is stated to be called Barung; and Bomba, a name that occurs also on Littledale's map, was the name of the district from

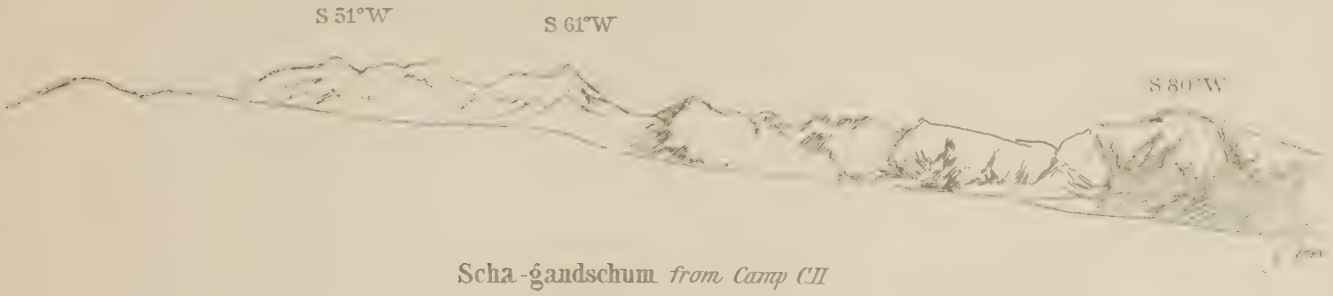
Fig. 84. VERTICAL SECTION OF THE BROOK.

which came the fresh guards who were to escort us farther west. The caravan forded to the north of my own route a brook called Scha-tschu. About the position of the Dung-tsang-tsangpo, I was unable to glean any reliable information. The Tibetans declared that the river, to which they gave also the name of Dschung-tsang, flows towards the east; my men maintained that it flows towards the west; while Littledale's map does not show in which direction it flows. The caravan, after we left it had followed the same route that Littledale travelled by in a more northerly latitudinal valley, and according to observations taken by the Cossacks they had halted at the following altitudes, 4860, 4876, 4803, 4804, 4735, 4763, 4779, and finally 4775 m., this at our common Camp CIII.



Looking S 10°E *from Camp CII*

Drawn by Dr Sven Hedin.



Scha-gandschum *from Camp CII*

rom Camp CIII

CHAPTER X.

TO THE LAKOR-TSO. ANCIENT BEACH-LINES.

October 13th. After granting ourselves a day's rest in this exceptionally pleasant and smiling locality, we resumed our journey north-west across a series of gullies carved in red and grey clay, which were extremely difficult and trying to our camels. None of them contained water, and gradually they converged upon the principal valley, that down which the stream of our camp flowed, but having united, they follow the common glen towards the N. 75° E., which finally enters the latitudinal valley up which the caravan had marched. The westward continuation of the latter is a gently ascending, narrow, flat latitudinal valley, its bottom consisting of soft material with grass. On the north it is bordered by low, rounded hills, and on the south by the somewhat loftier crest which is pierced by the glen in which stood our Camp CIII. The surface was undulating and we crossed over a series of flat spurs from the southern range. Across this latter, where it dips lower than usual, we caught occasional glimpses of the Scha-gandschum, in increasingly greater foreshortening. The western water-divide of the latitudinal valley is a very low, almost indistinguishable pass, with an altitude of 4,872 m. Hence the surface falls away exceedingly gently towards the west, through an increasingly broader valley, which eventually merges into a more open circular arena; in this we encamped beside a spring at an altitude of 4,860 m. The grazing was relatively good. It was impossible from Littledale's map to determine whether my route was coincident with his or not. Mollah Schah thought that we were still to the south of it.

This day the weather was favourable, for the wind was less violent than usual, and sometimes it even felt warm when the sun shone. The sky was clear, though a few tiny fleecy clouds showed themselves towards evening.

A yellow crystalline limestone predominated in this region; not far from Camp CIII it dipped 16° towards the S. 4° E.; higher up in the transverse glen it was quite vertical. From Camp CIV Scha-gandschum appeared perfectly foreshortened, being like a single round-topped peak bearing S. 27° E.

Although the grazing was better than usual, we saw no wild animals except hares.

In these high, cold regions, with their pure, dry air, the sunsets were not particularly beautiful. The sun drops in blinding splendour from the limpid blue sky, and it is only in the east that the transition from day to night is accompanied by any illuminative effects. In that direction the earth assumes a pink tinge, which shades away to a vast distance, the summits of the individual mountains and of the mountain-ranges alone standing out in more strongly-marked, deeper tints. In the zenith the sky is flushed a light rosy red, but on the eastern horizon it is blue, and the blue deepens rapidly; it is night rising in the east, a »reflection» as it were of those parts of the earth's surface in which night already holds sway. The black and blue-and-white tents of the Tibetans stand out distinctly, and we see their owners leading their horses and baggage yaks from one patch of grass to another. In the foreground the hard, yellow grass is sharply etched against the setting sun. This locality was said to be called Ramlung, and the principal chieftain of that region was reported to reside at Ob-genang, some sixteen days' journey towards the west or south-west.

October 14th. In consequence of the exhaustion of the caravan and the slow pace of the hired yaks, we were seldom able to cover more than 20 km. in a day: on this day, for instance, we did only 18.4 km. This brought with it however one advantage; it enabled me to make an accurate and detailed map of this part of Tibet and to take the absolute altitudes of a great number of fixed points; but unfortunately I was not able to make any side-excursions, owing to my having to husband the last remaining strength of the caravan. Our march towards Ladak was therefore very like a retreat, the governing idea of which was *sauve qui peut.* All the same it was in many ways an instructive journey, and held out many inducements to us to explore the adjacent regions with a better and more enduring caravan.

From Camp CIV we proceeded a short distance north-east in order to get round a shoulder of the mountain that stood in our way and so came into the latitudinal valley, which we followed for the rest of the day towards the west-north-west. Here again we found that the orographical architecture is not seldom so arranged that the springs of the watercourses are situated on the northern versant of the southern range, while the northern range is pierced by their transverse glens. This new latitudinal valley is essentially narrow, and the adjacent mountain-ranges are not particularly high; they are for the most part rounded in outline, though occasionally they break into stretches of wild crags and rugged spurs. The grass was thin and poor, and water very scarce: with one or two exceptions all the watercourses were dry. The pass on the first threshold of the latitudinal valley had an altitude of 4,813 m.; thus it was lower than our last camp. East of this stretches a trough-shaped gathering-basin, which is so far unusual and unlike others we had seen in that its principal stream breaks through not only the northern, but also the southern, range. Originating in the district immediately west of Camp CIV, it cleaves the southern range, runs close to and east of the last-named threshold-pass, follows for a short distance the latitudinal valley, and then, in order to avoid a small butte that rises in the middle of the valley, it swings away towards the north, and breaks through the northern range by a narrow glen. Through the

CAMP CIII.

ANOTHER VIEW FROM CAMP CIII.

Lindstr. A. B. Lagrelius & Westphal.

CAMP CV.

gap made by the transverse glen in the southern range we saw in the background mountains swelling up higher, and in part covered with snow.

The ascent up to the first threshold-pass is very gentle. Its summit affords an uninterrupted view of the next gathering-basin, which is more extensive and more complicated in construction. The range that borders it on the south does not appear to be pierced by a single one of its head-feeders; but on the other hand the opposite, northern range is cut through in no less than five different places. Whereas in general the different head-feeders unite into one stream before they pierce the range, that is to say in the latitudinal valley itself, in this particular gathering-basin each of the five brooks breaks its own way independently through the northern range, and it is only on the northern side of this range that they converge into *one* stream, that is to say outside the domain of their own latitudinal valley.

Fig. 85. SHEEP-FOLD. LOOKING NORTH FROM CAMP CV.

Descending from the pass, we continued west-north-west through the gathering-basin. Its principal drainage-artery begins on the pass itself and picks up a whole series of small rainwater channels, all more or less deeply grooved, that come down off the mountains to the south. Some of these occasioned us a good deal of trouble to get over. The latitudinal valley is broader on that side of the pass than on its east side. A transverse glen, called, I was told, Luma-biba, and coming straight from the south, ought possibly with greater right than the one just mentioned to be called the principal artery of the basin; even then it contained an insignificant rivulet from some adjacent springs. At intervals we observed fresh traces of encampments, though there were at that time no nomads in the neighbourhood. Through the next transverse glen, which is unimportant, and cuts through the northern range where it drops to the altitude of hills, we perceived the flat, extensive latitudinal valley which, so far as Mollah Schah could remember, was the

one along which Littledale travelled. There we detected the gleam of a level, chalky white expanse, apparently a desiccated salt lake of the same kind as those which are so numerous farther west. Possibly it is at times filled with water. The river, which in summer is formed by all the then dry watercourses that we crossed over, and that are separated by flat, inconsiderable thresholds, clearly makes its way into this temporary lake. On the north of the lake the big latitudinal valley is bordered by a mountain-range, which appeared to be about 30 km. distant. The second threshold-pass reached an altitude of 4,751 m., and the third, which is more marked, an altitude of 4,801 m. The district lying a little beyond the latter is called Godschu. There we came across grass, springs, and pools, some of which contained salt water, others fresh water. The altitude there reached 4,812 m. All day the wind blew hard from the west, though the sky was perfectly bright; at night however there was practically no wind at all.

Fig. 86. CAMP CV LOOKING EAST.

At some distance from our camp there were nomads resting, and from them we procured milk both fresh and sour.

On the 15th October the landscape was just as monotonous as on the days preceding: we continued through the same latitudinal valley, which hitherto had taken us to the west and then to the west-north-west. Generally it is narrow, and runs between two parallel ranges of mountains, of which that on the north is sometimes broken by transverse glens. Here therefore the ground slopes towards the north. On the south rises a vast upswelling of the surface, while on the north is the broad latitudinal valley through which ran Littledale's route. At first the range that we had nearest to us on the south was tolerably rounded and its northern flanks seamed by a number of pretty deeply incised watercourses. None of them at that time carried water; in fact throughout the whole of the day we did not pass a single running stream, or a single pool or spring; though on the northern face of the southern range we did see just once or twice a small forlorn-looking patch of snow.

From Camp CV we ascended a flat pass, with an altitude of 4,878 m., from which a channel runs down to the main stream that makes for the lake. Another similar brook proceeds to the same goal from the pools at the camp, and between the two rises a small free-standing butte. In dimensions the northern range is not inconsiderable. To the west of the threshold-pass the latitudinal valley widens out and assumes a more individual character. It becomes gently undulating, though its bottom cannot be said to have a decided fall in any direction, but is divided into a number of self-contained drainage-basins, all exceedingly shallow and hardly distinguishable by the naked eye. In the middle of the valley there exists no trace either of a main stream or of gullies. The mountain ravines terminate at the foot of the mountains themselves, being unable to make their way out into the lowlands.

At length, however, near a couple of miniature mountains rising isolated in the middle of the valley, we approached a scarce perceptible threshold and water-divide, on the west side of which the surface falls away exceedingly gently towards the north-west, until it reaches a flat, shallow trough or »sink». From that point we beheld to the north a fresh transverse glen, and gleaming white in its upper, broader part a sheet of salt, with a small pool in the middle. This is however contrary to what one would at the first sight expect, for one would naturally suppose that the lake, situated where it is, would have an outflow towards the north through the transverse valley, and consequently that its water would be fresh. It looks therefore as though this glen had ceased to act as a transverse glen and is now closed to the passage of water. If that is the case, the breach will be a reminder of a time when the precipitation higher up in the mountains was a good deal more copious than it is now and possessed the power to force its way towards the north. Through this opening we obtained however a very extensive view in the latter direction, the mountains standing one behind the other like the side-scenes in a theatre. I counted six different mountain-ranges, all running parallel to each other from east-south-east to west-north-west. The one farthest away, which may be regarded as the extreme northern boundary of this system of latitudinal valleys, is of imposing dimensions, and towers up higher than all the rest, effectually limiting the view to the north. It is sombre in appearance, and in that direction there was not a single trace of snow to be seen, the reason being that the slopes of all the ranges there visible to us are directly exposed to the southern sun. The latitudinal valley appears to be barren.

So far therefore as it was possible to judge from our line of march, the relief of the highland in this region is on the whole as follows. To the south, at the distance of probably some thirty odd kilometers, there runs a main range, which we saw but seldom owing to its being screened by the parallel ranges to the north of it. This great range is really a very noteworthy swelling of the earth's crust, running on the whole parallel to the Himalaya, the Kara-korum, and the Kwen-lun, and thus forming a boundary between the central parts of the Tibetan highland, on which we were then travelling, and the southern parts of the country, with its vast lacustrine regions and the upper part of the Brahmaputra and its tributaries, that is to say the western part of Tibet proper, which is almost entirely unknown. From that lofty and majestic border-range the surface descends in steps, though at the same time very slowly, towards the north, each successive latitudinal valley being but slightly lower than its neighbour to the south of it. This law was exemplified with especial force all along the route by which we had travelled; for all the transverse and diagonal glens had made their way into the great latitudinal valley to the north. Beyond this valley the country ascends northwards towards the big gloomy range, which may possibly be regarded as the continuation of the Kara-korum. It too is accompanied by a number of parallel ranges on its southern side, and consequently also by a whole series of parallel latitudinal valleys The conformation is the same as that which we found in the Arka-tagh, a main back-bone, with subsidiary ranges on each side of it. Under these circumstances there is nothing surprising in Littledale and myself travelling close beside one another

and yet keeping to different parallel latitudinal valleys. These run in fact so close together that I at least often found it impossible to determine whether I had one or more ranges between my route and his, or whether we both used the same valley. Seeing that the valleys are so perplexingly like one another, it is only a map drawn with the detailed completeness of mine that will enable us to recognize them again.

From the flat pass we descended into the equally flat, round cauldron-shaped valley, and then kept along the lowest part of the slope of the southern range. This necessitated our crossing over a great number of watercourses, which, like those last mentioned, come to an end the moment they emerge upon the lowlands, these being after all nothing more than an expansion of the valley that we were travelling in. To the west of the transverse glen we observed, on the other hand, a distinct watercourse, running immediately along the foot of the nearest range to the north, until it at length enters the transverse glen, though at the present time its summer flood does not appear able to get farther down than to the little salt lake in the upper part of the valley. The range which separates our valley from the big, broad valley to the north is by no means simple, at all events immediately west of the transverse glen, but it is divided into a number of more or less continuous parallel ranges. In one or two places I counted four of them.

Upon leaving this flat expansion we marched up the well-marked *thalweg* out of which the recently mentioned watercourse issues. Its surface is a good deal broken, and the sides of the glen descend abruptly to the stream that runs down its middle. Occasionally we were able to detect a slight tendency to the formation of terraces on both sides, an indication that the erosive activity was formerly more energetic. In front of us, that is to the west-north-west, rose a not inconsiderable reddish yellow crest, showing, like most of the mountains in that region, soft, though steep, outlines, with rocky points and buttresses projecting here and there, the last surviving portions of rock which have resisted the attacks of disintegration. The acclivity leading up to the pass that forms the western boundary and water-divide of the cauldron-shaped valley is steep, and is composed entirely of earth-covered slopes, furrowed by deep watercourses from each side. The summit of the pass itself is however flat, and reaches an absolute altitude of 5,075 m. Hence the latitudinal valley slopes slowly down towards the west-south-west, being bordered on the south by on accentuated crest, rocky, rugged, and wild. On its highest reaches lay a little snow; this occurred however only on the slopes looking north. In the upper part of a watercourse that comes from a small detached butte on the north side of the valley, we discovered a spring, with a Tibetan tent not very far away. This region is reported to be called Scholung. Its absolute altitude is 5,051 m. The rock continued to be the same as hitherto.

October 16th. Our course this day was towards the west and west-north-west, still up the same monotonous latitudinal valley, though for our wearied caravan it afforded in many respects convenient travelling. It is neither narrow nor broad; but the sides slope down all the way to the main stream, without leaving room in the middle for any level tracts. We travelled all day on the northern side of the watercourse, except for a short distance and then we marched in its

bed. We did not see a single drop of water all day, nor springs either, and the grass hardly deserved the name of grass. Nor did we perceive either tents or any indications of nomads having visited the region. The nearest range to the south now increased in size, and assumed the character of a sharp, wild, rocky crest, with a steep gravelly scree at its foot, scored by dry torrents. The northern range, consisting of the same rock as heretofore, is on the other hand lower, with longer, gentler declivities towards the main watercourse of the valley. The side-gullies which seam it are shallower and less numerous. The westward inclination of the valley, which was at first distinguishable, grows at last of the very slightest. Crossing the middle of the gathering-basin in which we had been travelling ever since leaving the last pass, we began to ascend slowly towards the threshold which borders it on the west. In point of construction this gathering-basin is unusual. It possesses two main watercourses, which descend one from each of the passes mentioned, and after picking up several contributories, join together to form *one* stream. This finds its way out of the latitudinal valley by a transverse glen, which, contrary to all its predecessors, proceeds south, piercing the great rocky range which rises on that side. Upon the middle of the basin, which is more broken, converge two moderate-sized watercourses that issue out of a culminating portion of the range to the north. The southern range also culminates on the left side of the transverse glen, rising into heights of a grand and imposing character. Through this transverse glen we obtained a fresh perspective towards the south, across a latitudinal valley which runs parallel to the one we were following and one step lower than it. But the hurried and incomplete view which we obtained across that valley was not sufficient to afford any opinion as to its orographical value. All the same it did not appear to be an especially broad valley, and it slopes towards the west, as I had an opportunity to convince myself later on. On the south it is bordered by a very considerable mountain-range, bearing small patches of snow, towards the west; while beyond this appeared yet two other ranges. The one farthest south is, I suppose, the main chain in the orographical system in that part of Tibet. If now we compare the features which characterise this tract with those which we encountered the day before, it would appear that the middle one of the three latitudinal valleys, that is to say the valley which we were following, lies the highest; for first it discharges its water to its northern neighbour and afterwards sends it to its neighbour on the south. Even now we appeared to be approaching a depression situated between these parallel ranges. At the point where we approached nearest to the transverse glen the altitude was only 4,843 m., a drop of more than 200 m. since leaving Camp CVI. The southern

Fig. 87. LAKOR-TSO; LOOKING S 75° W FROM CAMP CVII.

latitudinal valley lies therefore yet lower still, and as it slopes towards the west, there must exist in that direction a depression lower than any that we had struck for a long time. And the very next stage did indeed prove that such was the case. One of my Cossacks, who set out from Camp CVII to make an excursion towards the south, crossed over the southern range by an easy pass and from its top obtained an extensive view of the next latitudinal valley. Towards the west it expands, while towards the east or east-south-east, but at a great distance, it is bounded by a snow-clad mountain, possibly the continuation of the Scha-gandschum. Down the valley runs a stream of not inconsiderable size, and in the valley we perceived three small lakes or pools, besides three nomad encampments, with flocks of sheep and herds of yaks. Beyond that valley the country appeared to be quite impossible for a wearied caravan.

From the summit of the pass, with an altitude of 4,896 m., the surface slopes gently towards the west-north-west, and a fresh watercourse runs close along the foot of the southern range. In the middle of the flat valley there rises from the level ground a steep, isolated craggy pinnacle of the usual rock, with a dip of 26° towards the S. 50° E., though the inclination was not perfectly distinct. On its south-eastern side, and consequently in a position sheltered from the prevailing wind, there was a sheepfold built of stone; and immediately west of it a spring with some grass round it. This tract is called Tschadschap. The valley then continues to broaden out and grow more open, until it resembles a long plain shut in between two parallel mountain-ranges. Of these the range on the north is imposing and studded with a great number of sharp-pointed crags. The other range on the south is of far less magnitude, and exhibits rounded outlines, above which the hard rocky summits project here and there only. A glance to the west sufficed to convince me, that this range would soon come to an end, namely at the edge of the depression of which I have spoken.

We pitched Camp CVII at an altitude of 4,821 m., beside a small brook that issues out of a big transverse glen in the northern range. The upper part of this glen lies parallel with the main glen, so that in this locality the range is double. In its narrower parts the grazing, being better protected, was more abundant. This district is said to be called Dadim. Here we encountered a large number of kulans; at our arrival we counted close upon 200 head. Partridges were plentiful in the side-glens. It blew hard from the west all day, and with especial violence after 2 o'clock, when the sky became dappled with light clouds.

I will mention as a curiosity, which may possibly interest those who have studied the habits and characteristics of the domestic camel, that at this camp two of our she-camels dropped young during the night, each half a year old; they at once died and were devoured by the dogs. The mothers took the matter with unruffled serenity, and ate away with a good appetite all the next day, which we devoted to rest. As these miscarriages took place simultaneously, it may be assumed that they were brought on by one and the same cause. The cold had not been more severe than usual, — 15.4°; but possibly the two camels had drunk too greedily of the icy cold water or eaten something amongst the grass that was injurious to them.

On 18th October we made an interesting journey of 20 km., down into the depression of which I have spoken, and which contained a lake. The brook that flowed past our camp soon died away in its channel, its little rivulet not being able to get down to the principal drainage-artery of the latitudinal valley. We forded it, and having the valley diagonally towards the west-south-west, kept along the foot of the southern range, the distance across to the reddish range on the opposite or north side of the valley being rather great. In front of it stand at intervals smaller foot-hills and heights, of a more rounded external appearance. At the beginning of our day's march we encountered corresponding hills at the base of the southern range. From this range too there issue a number of transverse glens, with deep-cut, difficult ravines. It would have been far more convenient for us to have travelled towards the lake along the middle of the valley; instead of that we followed the advice of our Tibetan guides, who induced us to incline to the south-west towards the outlet of a big transverse glen; it led, they asserted, to an easy pass, which we must cross over in order to get water and grazing at night. A preliminary examination convinced me however, that this road was impracticable for the caravan. The ascent to the top of the pass was through a narrow gorge filled with gravel and stones, with rugged spurs on both sides, but the actual pass itself was easy enough. This road would indeed have been a good deal shorter; but the longer route which we selected was far more convenient, and, what was more important, far more instructive. We were now so high up on the detritus slope of the range, that we could make straight for the lake, though this necessitated our crossing over an endless number of disagreeable, deeply incised eroded channels of the same kind as the *tschaps* of Kirk-saj in East Turkestan. The sides of some of these are so steep that we had to cut steps with our spades before we could get the camels over. Here again it would have been better to have kept to the middle of the valley, where the surface adjacent to its principal drainage-artery was level and made easy going. But after we had crossed over a minor offshoot of the range by means of a small convenient *bel*, the country became more favourable.

Thence an unwonted view disclosed itself. We again saw the lake to the west-south-west. From the *bel* runs in a regularly curved arc a high, conspicuously modelled shore-rampart, north, north-west, west-north-west, and west, until it is interrupted by minor bluffs on the northern shore of the lake. This natural circular rampart, the top of which would be about 50 m. above the existing level of the lake, is the highest and oldest indication in the bottom of the latitudinal valley that points to the lake-basin having formerly covered a more extensive area. The rampart is broken in the middle by the main stream of the valley. As we travelled on farther towards the south-west, we encountered seven similar shore-ramparts; but as they are smaller than the first one, although at the same time clearly and energetically constructed, we may conclude, that the lake maintained for a relatively long time the position and area indicated by the highest rampart, thus affording the wave-action a better opportunity to shape it. Add to this, that each of the lower ramparts points to a successively smaller lake area and an increasing diminution in the power of the waves, under the influence of the west wind, to build up

ramparts. We ascertained subsequently, that on other parts of the lake-shore beach-lines run at a very appreciably higher elevation than the highest rampart at the beginning of the latitudinal valley. Accordingly I was surprised to find no other rampart preserved above this one in the valley itself, and all the more so when I remembered that the circular rampart which I have just described is the oldest of all and yet is the biggest, so that it has possessed sufficient power to withstand the destructive energy of the atmospheric forces and of disintegration. We must suppose therefore that the lake formerly thrust a deep bay into this latitudinal valley, which reached a long way above the highest of the still surviving ramparts, but that it did not maintain it sufficiently long at that altitude for it to be able to build up ramparts, and shape them, and leave them of the same dimensions as the big rampart. Either the lake fluctuated at that period, and so conspired to level the then existing latitudinal valley, or else it dropped so swiftly that the wave-movement was not able to build up ramparts strong enough to resist destruction. Finally, I would call attention to the more or less exposed position of the beginning of the latitudinal valley in relation to the deposition of sediment from off the neighbouring mountains. Camp CVII, which has an altitude of 4,821 m., belongs to a part of the latitudinal valley which under any circumstances lies considerably higher than even the highest of the beach-lines that I measured subsequently beside the Lakor-tso. It is about half-way between that camp and the lake-shore that we have to look for the point which lies at about the same level as the highest of the beach-lines which I measured, or 133 m. above the existing level of the lake. And from that point onwards I expected to find at any rate faint indications of beach-lines at the same level at which I measured them elsewhere. As a matter of fact however I did not find any. This may be in great part due to their having been levelled down, covered over, and gradually planed away by the solid material, the products of disintegration and sedimentation, which have been carried down by chance streams from off the slopes of the mountains to the north, and deposited in the lowest parts of the latitudinal valley. On the other hand, the southern range, in which we found such a great number of gullies and watercourses, was unable to make any contribution to the work of covering over, because all its tributaries terminate in the main stream of the valley, which brushes the foot of the range on that side. But why, it may be asked, have just these shore-ramparts been obliterated, whereas those which begin at the big sweeping curve are still in a good state of preservation? The probable reason is, that just there the northern range inclines to the west-north-west, and between its continuation and the old bottom of the lake in the lowest part of our valley there stretches a small ridge, or rather a series of minor mountains, that are frequently interrupted and detached, but still fairly sharply outlined and craggy. These subsidiary mountains serve as a protecting wall against the streams which have flowed south off the slopes of the northern range, bringing with them detritus and sediment. Between the northern range and the subsidiary mountains on the northern shore of the lake runs the latitudinal valley in which Littledale travelled, thus leaving Lakor-tso to the south, although he saw the lake from his line of march and entered it correctly by name on his map. From this point therefore my route runs a good deal farther south than

Ljustr. A. B. Lagrelius & Westphal.

LOOKING S. W. FROM CAMP CVIII.

his. Properly speaking, the latitudinal valley in which he travelled is the direct continuation of that in which stood our Camp CVII; but it may also be said that, in consequence of the subsidiary mountains which I have just mentioned, the valley in question bifurcates in this locality. The southern division widens out rapidly in order to make room for the Lakor-tso, as well as to effect a junction with the important valley which we had nearest to us on the south, the valley in which our Camp CVIII was situated.

To return to the shore-ramparts that still survive and the lowest part of the valley. They appear, then, to owe their existence to the fact, that they were protected between the subsidiary mountains on the northern shore of the lake and the extreme western part of the southern range, which possesses few transverse glens, while such as do exist are short and insignificant. The main stream of the latitudinal valley, which is quite distinct all the way to the gap in the biggest and highest rampart, stops there, and beyond that point no traces of erosion are discoverable. Nevertheless the breach in the rampart and the clearly defined channel of the stream down to that point prove, that the water does succeed in still getting down as far as that. After a heavy rain the stream will be pretty heavily charged with sediment, and one would expect that this sediment would deposit itself as flat alluvial sheets over the lower shore-ramparts. Yet, since this does not take place, the sediment appears to be deposited before it reaches the highest rampart, while the water runs away by a subterranean channel. But it reappears again, at any rate in part, before it reaches the existing lake, as indeed we shall soon see.

There is yet one other circumstance which must be taken into account in instituting a comparsion between that part of the bottom of the latitudinal valley which still possesses ancient strand-ramparts and the part in which they have been obliterated, and that is — time, and the changes which have meanwhile taken place in the climate. *A priori* younger strand-ramparts and lacustrine terraces have a better prospect of being preserved than older ones; but this probability is of less importance than the circumstance, that the lake is undergoing desiccation as a consequence of the increasing aridity of the climate. Hence at the present time the sedimentation from the bordering ranges is less active, as well as less effective, than it was at the time when the lake reached an extension such as that indicated by the beach-line which I measured at an altitude of 133 m. at Camp CIX. For this very reason too the oldest strand-ramparts, if indeed there were such, though they have now vanished, would be in a higher degree exposed to be covered up by sedimented detritus. Any way it is curious, that just the highest of the eighteen strand-ramparts, of which we crossed over eight in all, should be the biggest and best developed. But apart from the hypothesis which I have thrown out above, that the lake, when it reached up to the level of that rampart, maintained its then existing-level for a long period of time, the climate being then in a measure constant, we ought also to recollect, that this curving rampart itself stretches from the little pointed offshoot of the southern range and the nearest rocky portion of the subsidiary mountains on the northern shore of the lake, and in consequence of that situation is indubitably better protected than the lower ramparts.

West of the spur in which the little *bel* is situated, we crossed over the extreme tips of three similar minor spurs before we reached the level floor of the valley and the former lake-bottom. Thus we did not cross at all over the second and third beach-lines counting from the top; but we did cross over the fourth, fifth, and sixth, and each of these three manifestly forms a terrace. The seventh we passed quite close on our right hand; and we also crossed over the eighth, ninth, and tenth, these being of rampart shape. The accompanying contour sketch (fig. 88) will illustrate the difference between the three upper beach-lines and the three lower ones. These beach-lines are curved like an arc, just as the highest one is, although the arc grows of course wider the lower you descend, because the valley opens out like a trumpet in this direction. The beach-lines from the eleventh to the eighteenth we did not touch at all, but we left them to the right, that is north-west of our route. I need hardly say that these curves are not parallel to one another, for they lie closer together on the steeper slopes, but wider apart in the middle, where the bottom of the latitudinal valley is flattest.

Fig. 88.

One interesting circumstance connected with the six lowest strand-ramparts is that each of them dams up behind it a long, narrow, crescentic lagoon, and these contain increasingly greater quantities of water in proportion as you descend towards the lake. Similar lagoons, which formerly existed behind some of the upper ramparts, have recently dried up, as was evident from certain expanses of yellow mud which we observed. These formations prove clearly, that the stream, in such seasons as it flows at all, really does possess a subterranean course all the way down from the highest rampart, and that it gradually emerges again in the form of springs, the water from which is dammed back by these ramparts. Since however the water, although temporarily held up, is always trickling down from the upper lagoons towards the lake, it naturally follows that the lower-lying lagoons, which receive increments from all those that lie above them, are the largest in size.

Fig. 89.

To the north-west we saw the northern end of the lake, forming a regularly shaped shore-line. In the same direction there appeared to be a pass, but a rather high one. It was in the latitudinal valley over on the other side of this pass that Littledale travelled. On the north-east, north, north-west, and west, the shores of the lake are encroached upon by small spurs of the mountains and detached offshoots

of moderate elevation. In the direction in which the latitudinal valley terminates, that is north-east of the lake, the shore is extraordinarily flat. There it gleamed as white as snow; it is however covered with salt and gypsum powdered to dust and perfectly dry, as was evident from the thick white clouds, which, blown up from the shore by the westerly wind, hung in the throat of the valley like the steam that escapes from a locomotive (fig. 89). The Lakor-tso is at the present time a rather small lake. Its water is of a dark green colour, its tint being especially beautiful and vivid, though at the time we saw it, it was streaked with white-crested waves. The deep colouring of the water was rendered all the more conspicuous by being framed about with the ring of pure white shore, sometimes wide, sometimes narrow.

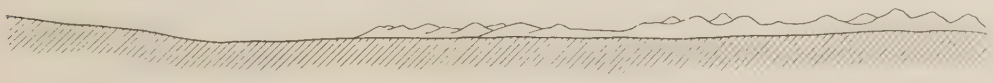


Fig. 90.

The range on the south of the latitudinal valley is rugged, craggy, and bizarre. Its last transverse glens have been modelled with great energy, and separated from one another by steep fantastically shaped offsets. At length that range comes to an end in a sharp, pointed promontory, at the foot of which small knobs of gypsum, only a couple of meters high, project above-ground. When seen from the south, the extreme western section of the range presents the appearance of a very steep, often precipitous, wall, or rather a steep staircase with high steps or treads. Upon reaching the promontory which I have just mentioned, we left the latitudinal valley, and soon afterwards entered its neighbour on the south. Indeed it may be said that »our» latitudinal valley actually comes to an end on the western shore of the lake, for the pass to the north-west, which I have recently mentioned, lies so high that it makes a distinct boundary to the valley in that direction. It is only the northern part of the lake that belongs to that latitudinal valley, for the lake itself lies in a depression, upon which three or four latitudinal valleys debouch from the east. Accordingly the regular orographical structure, which we had repeatedly observed during the immediately preceding days, comes there to an end, and gives place, as we shall soon see, to a different type of formation, although even then it was not difficult to detect signs of the prevalent law, that all the mountain-ranges are drawn out from east-south-east to west-north-west.

A few hundred meters west of the pointed end of the southern range there rises from the floor of the valley a round, dolphin-backed, detached butte of no great size, with, so far as we were able to see, its western foot standing close to the edge of the lake. Hence we may assume, that on that side of it (the west) the beach-lines run particularly close together. Between the end of the range and this butte, which, properly speaking, is the western extremity of that same range, there opens a broad »gateway» giving an uninterrupted view of the flat country to the south. A high and well-developed rampart, of precisely the same consistency and appearance as that which lies highest in the valley, runs diagonally across the »gateway», like a threshold or bridge, abutting at each end upon the base of the

mountains. But this rampart clearly lies at a lower elevation than that in the latitudinal valley.

Continuing on towards the south, we came down into a flat basin, containing a good deal of hard ground, underlain with thin deposits of clay. On its sides too old curved beach-lines were visible. This basin was once a bay of the lake, cutting pretty deeply in towards the east. Immediately on our right we passed a peculiar expanse of snowy white gypsum, built up into pyramids and cones 4 to 5 m. high, hundreds of them standing close together within a limited area (fig. 90). On the south this old lacustrine bay is bordered by two minor mountain-masses stretching east and west. Several of the beach-lines round it are very distinct, although seldom so well developed as those in the latitudinal valley. On all the mountain-slopes in the vicinity beach-lines are likewise visible, often giving the former a streaky appearance. Very frequently these long dark lines can be followed with the naked eye, as they run along, horizontal and undeviatingly parallel one with the other. Judging by the eye, the highest may have been situated at about 60 m. relative altitude. Here the higher-lying beach-lines appear to have been exposed to a more active disintegration, and consequently they have been for the most part planed away.

Fig. 91.

The western of the two small mountain-masses which border the bay on the south sends out a flat offshoot towards the north-east, and it is continued by a rampart possessing precisely the same properties as the two preceding ones; that is to say, it consists of sand, earth, and fine gravel, the whole consolidated into a hard mass, possessed of great powers of resistance. This rampart, which is about 10 m. in height, and has a very steep slope to the south (fig. 91), separates the bay, which we have just been considering, from another more to the south of it. The latter is however considerably narrower, and possesses moreover the peculiarity of being overhung by mountains on the west and being open on the east, where it forms part of a basin inclosed on almost every side by mountains. The seven beach-lines, which we counted in this bay, consequently turn their convex sides towards the west, whereas those of the more northerly bay turn their convex sides towards the exactly opposite quarter. In other words, the two basins slope in opposite directions. From our line of march I was unable to make out whether the southern bay is a continuation of its northern neighbour, in which case the two would make a single bay with a big bend in it, or whether the latter does in fact belong to a separate, dried up basin, that is to say a smaller lake by the side of the larger one. The former seems the more reasonable view, because the rampart which divides them does not reach all the way to the foot of the mountain that fences in the northern

bay on its northern side, but leaves open between the two a gap with level ground. If that is the case, the southern bay will lie at a slightly higher level than the northern bay, and its beach-lines will mark a higher and older stage than those of the northern bay. Details of this character can however only be settled with the aid of levelling instruments and at the cost of making a prolonged stay in the locality. During the return journey to Ladak which I was now engaged upon, a journey which only allowed me to make hasty reconnaissances, I had, for easily intelligible reasons, neither time nor opportunity to carry out such investigations.

Between the two small mountain-masses there exists also a fourth rampart, of the same appearance as the preceding, although it reaches up higher, namely to about 20 m., and is of orographical rather than of lacustrine origin. It forms an isthmus or threshold between the two mountain-masses, and is no doubt to be regarded as an especially low part of the crest that is represented by those masses. In exterior shape and in consistency it is however the same as the other ramparts. Ensconced between these two mountain-masses and the rampart lies yet another little bay, open towards the south and possessing the usual beach-lines. Immediately to the west of it, and lying between two mountain-spurs, is a similar bay, opening towards the south-east. Thus from the subsidiary mountain there radiate no fewer than four bays, all running in different directions, though all doubtless at some time connected with the Lakor-tso. At that time the subsidiary mountain will have been a rocky islet, and at an even earlier period it will have formed two similar islets.

CHAPTER XI.

THE LAKOR-TSO AND ITS BEACH-LINES.

We now beheld, to the north-east and east, the southern slopes of the rugged, craggy range along the northern foot of which we had recently marched. From the little threshold-pass we obtained an uninterrupted view of the next latitudinal valley, which comes from the east and at this point debouches upon the Lakor-tso depression. The surface inclines gently towards an expansion of this valley. Next we crossed a definitely bounded area, dotted over with gypsum mounds. Grass began to make its appearance and on the northern bank of a not inconsiderable stream it was of relatively good quality. On the right or northern bank of this stream we formed Camp CVIII, at an altitude of 4578 m. above sea-level. This district was called Tsotschin-nagmo by some of the Tibetans. The river is said to be the Some-tsangpo, though others asserted that it was the Nevu-tsangpo, while yet others, and they seemed to be the better informed, told me that the latter name belongs to a stream flowing farther to the south. On the south the new latitudinal valley is bordered by a range of moderate elevation, then slightly sprinkled with snow. This is said to be the Dargin, and beyond it again rises a snow-capped mountain called the Tschingbo-gangla. To a snowy mass visible a good long way off in the west my Tibetans gave the name of Marmik-java-godsom, and to the range on the north side of the valley which we had last traversed Amur. My Tibetan escort endeavoured to induce me to return to the latitudinal valley by which Littledale travelled; they appeared to regard it as the natural »gutter» by which to get rid of undesirable Europeans. But when I declared that it was my intention to follow a more southerly route, they admitted, that from that locality two roads lead west, though they unite again after three days in a district called Schabgo. The southern route is said to pass through the district of Luma-nagmo, the northern by the side of Serkem, a mountain situated to the north-west. After the two routes reunite, they traverse a district called Dschivu-tsaga, in which is a salt lake. Our escort was repeatedly changed; the guards who now joined us said they were subject to the chief Jamnu Bombo, who ruled over the district of Sengor, from the eastern boundary of which we were then reported to be a couple of days distant. West of it lies, I was told, the country of Girki, and beyond that Tok-dschalung. Several of these names are not reliable, because I had no means of checking them.

The river Some-tsangpo, together with its valley, struck our camp from the S. 73° E. Its water was collected into *one* channel, though just below our camp it divided into several shallow arms, that flowed over alluvial flats and sand-banks. Its right bank consisted of a terraced escarpment 3 m. high, with a steep or vertical descent into the bed of the stream. It was composed of closely compacted sand, in part bound together by vegetation. Its left or southern bank is flat; but on that side also, though at a greater distance away, there is a well-marked terraced escarpment, manifestly indicative of an older level of the river-bed. East-north-east

Fig. 92. LOOKING S 20° W FROM CAMP CVIII.

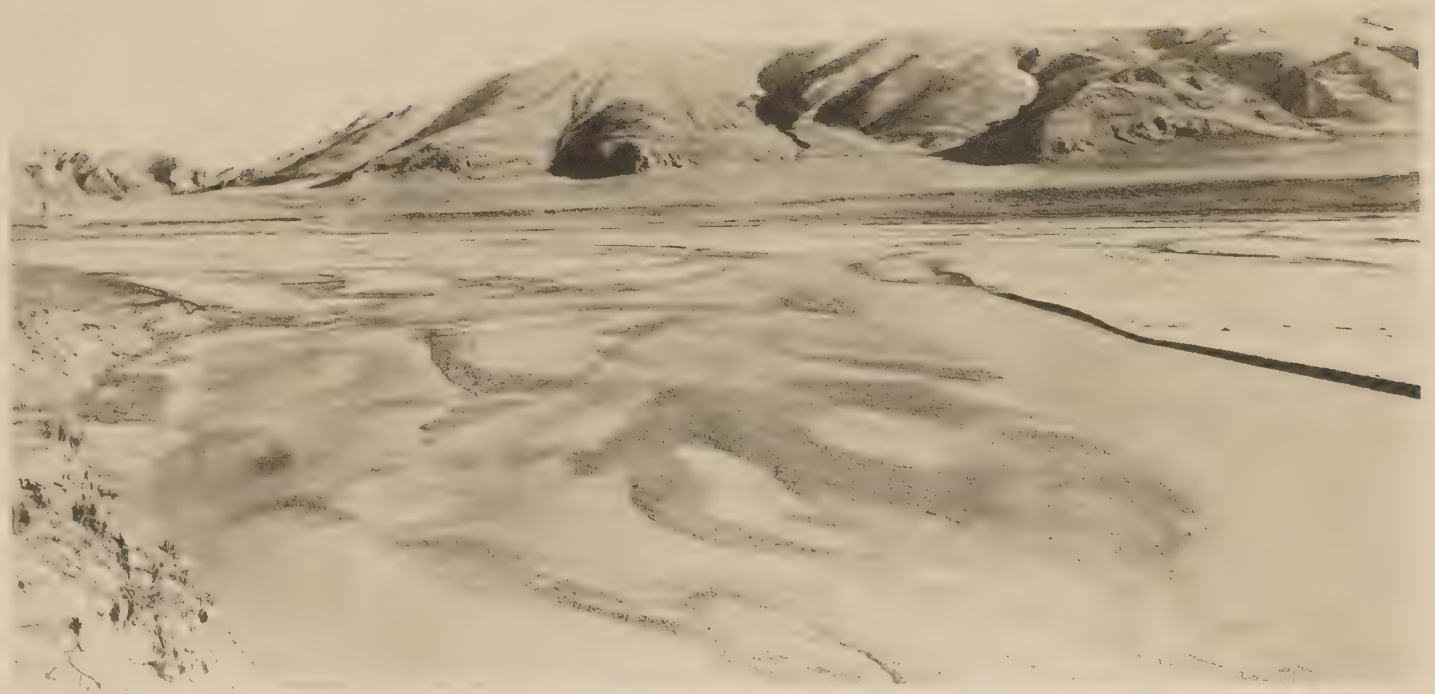
of the camp rise some more or less isolated rocky bluffs, imparting an appearance of irregularity to the latitudinal valley on that side. Those that were nearest to us constricted the entrance of the valley, making it narrow. To the S. 20° W. in the southern range yawned a rocky gateway or deep-cut gap. This apparently gives access to a fresh latitudinal valley, and beyond *it* again rises another lofty range, in part then mantled with snow, and preventing, at all events in that part, all further progress towards the south. To the west stretched a chaos of mountains, the orographical structure of which could not be understood without penetrating in amongst them.

The rock was the same as heretofore. On the spur at which the highest rampart starts it dipped 66° towards the S. 43° E. At the sharp bend the gypsum rose into hard, rough elevations; but on the two adjacent areas, on which it formed pyramids and mounds, it was soft and loose as powder.

All day the wind blew hard from the west, half a storm in fact, and so it did on the 19th October. The latter day we gave up to rest. In the morning the river was frozen; but by 10 a.m. it had dropped 2 dm. below what it was the preceding afternoon, and there was nothing left of the ice except narrow, knife-edge braidings along the banks. But by noon all the ice had disappeared and the river rose again. Its water was perfectly clear; but the volume was quite insignificant, only about 1 cub.m. at 10 a. m. The marks in the bed showed however that in summer the Some-tsangpo can swell to a very considerable stream. By the afternoon the volume had increased to about 3 cub.m., and the water was muddy, occasioned in great part by the friction of the ice against the banks. As by 9 p.m. the thermometer had again dropped to — 10°, and the sky was perfectly bright, without a breath of wind, we heard the frost weaving its thin coverlet across the water; though even during the night a narrow channel of running water remained open in the middle.

Hard though the wind blew on the 19th, it blew still harder on the 20th October; in fact it blew a gale. From 7 to 8 a.m., and possibly also earlier during the night, a slight, but icy, wind blew from the east; no doubt it was the wind that usually descends the valleys in this region. From 8 to 9.30 a.m. it was a calm, and then came all at once the usual violent westerly »trade wind», and at 1 p.m. it changed into one of the most terrific hurricanes that I have ever experienced in Tibet. Here again I had an opportunity to observe how, in consequence of the dry, powdery nature of the soil, a not inconsiderable transportation of solid material takes place in certain localities with the assistance of the wind. This was in fact so heavily charged with clouds of dust and powdered gypsum that the face of the country was sometimes completely hidden from our sight. Picking up these white clouds on the western shore of the lake, it spread them like a veil over its waters, so that the lake looked like a gigantic cauldron all aboil, steaming, smoking, and hissing; while similar trailing fringes and comets' tails of white dust went drifting in amongst the mountains. At this time we were riding along the lake-side, and the wind struck us with such violence that it made the camels rock and reel, and those who were on horseback had to sit tight to keep their seat. These white clouds and the intense glitter of the shores were so trying to the eyes that even the Mussulmans and Cossacks, who are not very sensitive on that score, actually had to put on blue spectacles. And from the way in which the animals also kept blinking their eyelids it was plain, that the glare was objectionable to them.

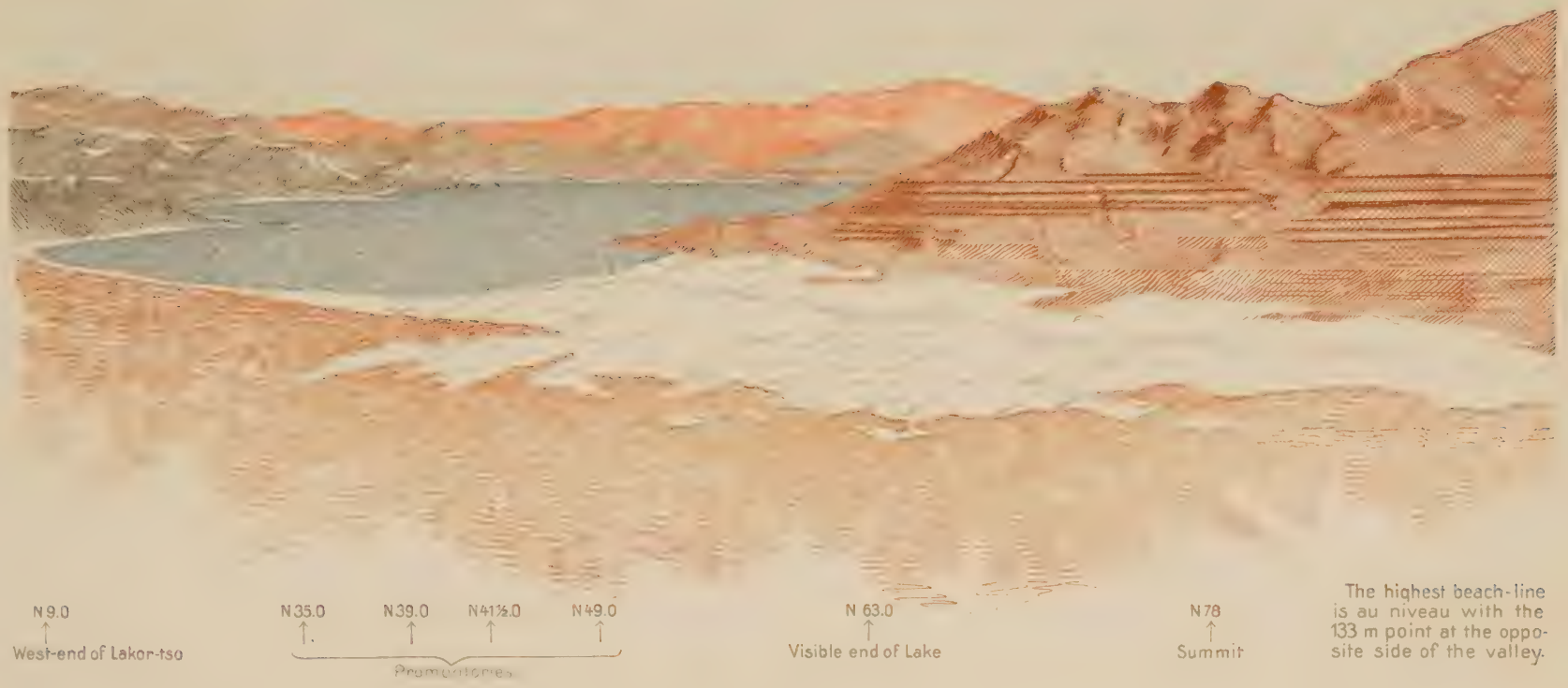
When we started again we first forded the river and then proceeded to travel west. After fifteen degrees of frost (C.) the ice was stronger than on the morning before, but there was still an open channel down the middle of the river. Nevertheless the ice was not so thick but that the animals trod through it; the bottom of the channel was also frozen, and on it the camels kept slipping. For a good long way we had the river immediately on our right; generally it is bordered by scarped terraces 2 m. high and consequently its bed is sharply defined. Between it and the southern range extends a long, narrow strip of hard, perfectly barren gravelly ground. We then passed the gap in that range which leads by an easy pass over to the next latitudinal valley and, on our right, a small detached butte, which however



Lemstr. A. B. Lagrelius & Westphal.

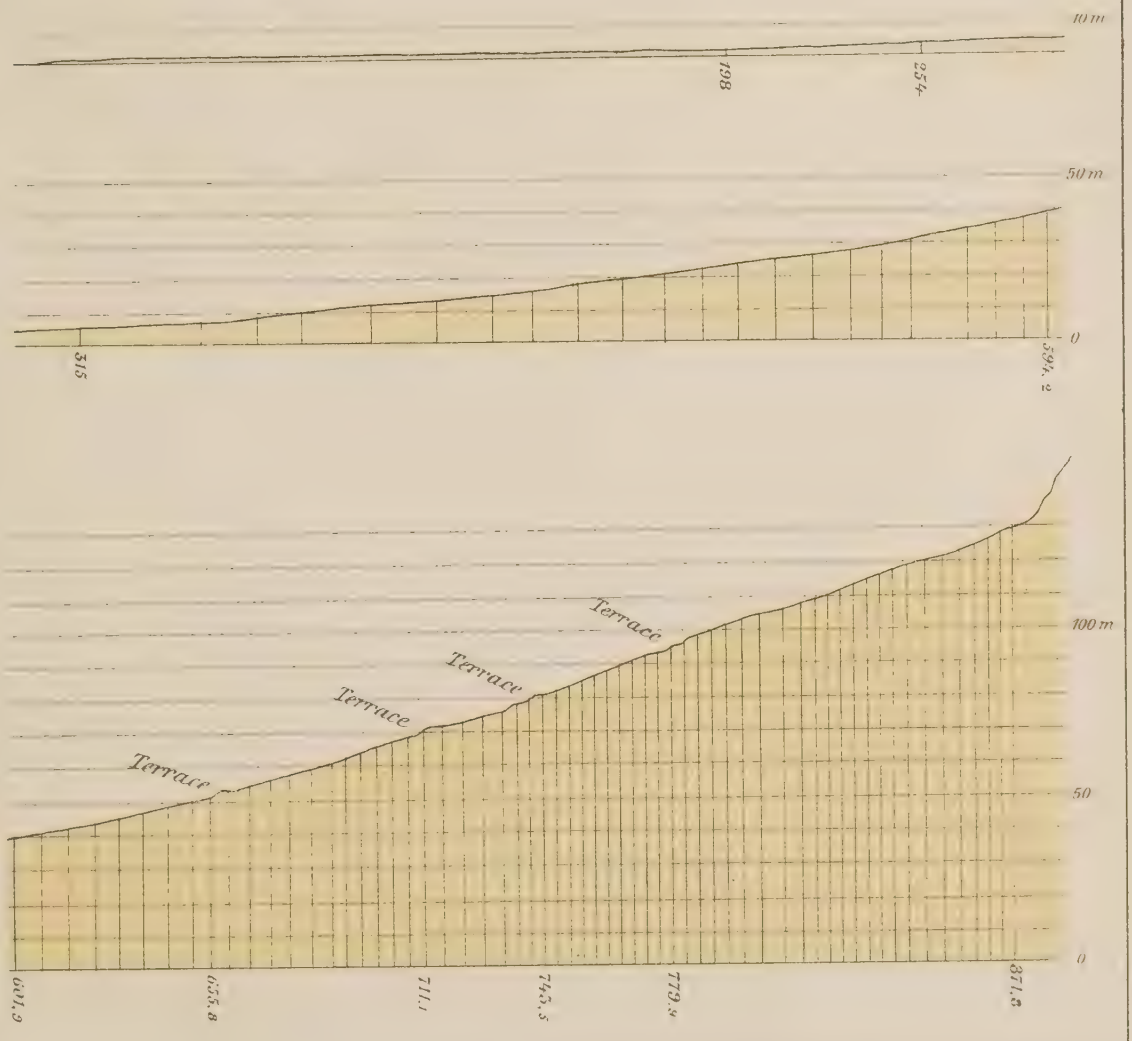
LOOKING S. 40° E. FROM CAMP CVIII.

Panoramic view of Lakor-tso from the 133m point above Camp CIX

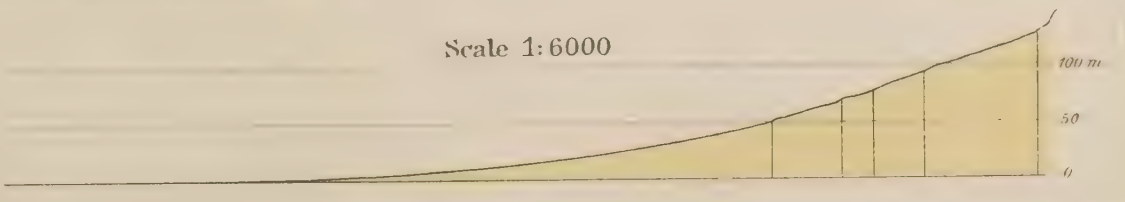


Vertical section of beach-linies or terraces at the S W shore of Lakor-tso

Scale 1:2000



Scale 1:6000



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was soon succeeded by a larger one, drawn out east and west. Between the two we observed another area of gypsum mounds. The river, after hugging closely the foot of the latter butte, turns abruptly to the north, as also does its latitudinal valley, though this soon terminates at the lake. Here again the valley is bounded on the south by a moderately high range, which culminates right at the elbow in a sharp-pointed, rugged, dominating peak, with steep shelvings. Here again regular beach-lines were often observed running like cornices along the slopes. We noticed a flock of wild-sheep, an animal that is scarce in this part of Tibet.

From the bend in the valley we marched towards the north-west, leaving the river behind us. This winds away to the north, until it expands into a small delta on the shore of the Lakor-tso, which we were slowly approaching. At the point where we at length reached it a spur from the southern range advances close up to the shore. The triangle made by our route, the river, and the lake-shore is covered by an expanse of gypsum, exhibiting the usual features. At its western end, next the mountain spur, there is a string of small salt lagoons and marshes. The shore there is extremely flat and very irregular in outline. The western and north-western shores of the lake are overhung by wild and lofty mountains, though in the haze of the storm that was then raging they presented themselves merely as a confused blurr. For this reason we continued some distance along the shore, the ground being level and good for marching on. I got the impression, that the lake must be shallow, for as far out as we were able to see the water gleamed here and there a light green, though generally it is a dark green. Probably the deepest part of the depression forms a flat, level saucer. The areometer showed that the water had a sp. gr. of 1.060.

From a promontory jutting out into the lake, and forcing us to turn to the west-south-west, we obtained a general view of the western end of the range which we had hitherto had on our left hand; it is both wild and rocky. Immediately to the west of it, though separated from it by a gap, rises yet another big bluff. Climbing up several steep step-like terraces, marking former higher lake-levels, we at length reached a broken plateau, which lies, I dare say, about 30 m. above the lake. On the south-west the descent from this platform is steep; and after that we had to cross over a whole series of deeply cut and difficult gullies or water-courses, all terminating at a gypsum expanse of the usual character. Across the lower part of it flows a river, coming from the S. 20° E. down a big valley, which stretches away to the south-east, affording an extensive view of mountain-spurs jutting out *en échelon* from each side. This big valley thus debouches upon the Lakor-tso. Its lower part, now occupied by gypsum deposits, is very flat and level, and was at relatively no great distance of time a bay of the lake. The river was then carrying but little water, perhaps half a cubic meter; nevertheless there were fish in it. One of the Tibetans declared, that the road from Ladak to Lhasa runs through this valley, or at any rate *one* of the roads does. We pitched Camp CIX at some distance from the west bank of the stream and at the foot of a mountain, being only a few, possibly not more than 2 m. above the surface of the lake, which itself has an altitude of 4600 m.

We were now surrounded on every side except the north by fairly high mountains, giving rise to picturesque scenery, which unfortunately I was unable to photograph because of the violence of the wind. Along the slopes we perceived in many places the characteristic dark lines and cornices, the origin of which cannot admit of a moment's doubt when their perfectly horizontal courses are borne in mind.

At the spot where we first struck the lake, the rock consisted of very hard conglomerate, dipping 30° towards the N. 52° E., and at the point where we again left it behind us the same specimen of rock was dipping 83° towards the N. 30° E., though of this I am not perfectly sure. The strata appeared however to dip predominantly towards the north and north-east, for the southern slopes of the mountains are always steep, as they were during the preceding day's journey. The soil of all the low, level expanses, or valley embouchures, that open upon the lake is heavily impregnated with gypsum. It gleamed white through the sand and gravel, and clouds of white dust were whirled up in the track of our caravan. This expanse of gypsum, with its white mounds, pyramids, and knobs rising only a few meters from our camp, formed a very strange and unusual spectacle. Its outer margins were just as sharply drawn as those of the other similar areas which we had passed. This glittering white expanse, embedded amongst the dark mountain walls and lying beside the green waters of the lake, gave to the scene a remarkable air of chilliness and desolation; in fact, it looked more like a snow-drift, in which the snow had assumed unusual shapes, or like the rough and porous surface of a glacier exposed to the melting influence of the summer sun. Apart from these little elevations, the surface of the gypsum expanse was perfectly level, that is to say its base forms practically a plain. That the gypsum was derived from the lake, and was deposited on its former bottom, is perfectly evident, for the white level expanse continues a little way in under the water. Originally these gypsum deposits were horizontal, the horizontal rings can be distinctly seen in the sides of the mounds; but erosion, rain, and wind have all conspired to eat them away and make their surfaces irregular. The effects which the wind produces here during the dry seasons of winter and spring are the same in kind as those which we have studied in the Desert of Lop, though the irregularities of surface there are of a different character, namely the parallel jardangs. When you walk between the mounds towards the interior of the expanse, and find that the white surface is soft and brashy, often thin and powdery like potato flour, you are astonished that the entire deposit was not long ago blown right away by those violent westerly winds. Seeing however that this particular expanse rises only a very slight degree above the existing level of the lake, at our camp only about 2 m., it would seem that the area has been exposed at relatively so recent a date that the wind has not yet been able to complete the work of destruction. A specimen of the gypsum which I brought home with me has been subjected to a preliminary analysis by Mr. G. Aminoff, and he tells me that »it consists for by far the greater part of round particles of gypsum, amongst, which occur a smaller number of angular grains of quartzite.» The latter are being carried thither now every day by the wind, and formerly, when the area was under water, by both wind and brooks. The river appears practically to disappear in the

lower part of this gypsum expanse, though the hollow which forms its continuation can be seen for a long distance. Opposite its mouth lie a couple of small islands composed of the same white gypsum.

On the 21st October we had magnificent weather, the wind being less violent than usual, nor did it freshen up until the afternoon. The sky was as always bright and pure and of a deep blue, and the vivid sunshine in which the scene was bathed caused its bold, bizarre, and shattered relief forms to stand out with extraordinary distinctness. From Camp CIX we had a magnificent view of the western fork of the range whose northern foot we were following. Its most northerly culminating peaks were visible to the N. 69° E., its loftiest crags to the S. 83° E., while yet

Fig. 93. CAMP CIX.

another great pinnacle towered up to the S. 63° E. These mountains consist in great part of detritus, sloping down evenly and rather steeply, with sharp summits, peaks, and ridges rising above it and boldly cleaving the sky far above, their flanks shrouded in the gloom of the shadows cast by the intense sunlight. To the S. 49° E. we observed a gap, with a transverse glen in it that unites with the main valley in which the river flows. Its termination was visible to the S. 27° E. The river is said to bear the same name as the lake, namely Lakor, though some pronounced it Lagor. It is up its slowly ascending valley that the road from Leh to Lhasa is said to run; so that hitherto we had been travelling to the north of it. Two of my Cossacks, who rode a good bit up the valley, thought they saw, from a suitable point of vantage, a smaller lake, and it was from it they assumed that the river originates. This is very probable, especially when it is remembered that the river Lakor, notwithstanding its very small volume, contained fish. The volume which it then bore is no doubt constant during the winter, and is for the greater

part derived from springs; though it will undoubtedly be frozen, perhaps right to the bottom, and will give rise to vast ice-sheets in the floor of the valley. Under these circumstances the presence of the fish would be accounted for by the issue of the river out of a lake, for they can of course retire into it when the river freezes. But end of October though it was, the fish proceeded, as we have seen, as far down as the vicinity of the salt lake. As for the gypsum expanse near the embouchure, it narrows rapidly up-stream to a tapering point, though above that there are still a few detached patches. It is just possible, that what the Cossacks took to be a lake may in reality have been nothing more than another gypsum area. Anyway the point cannot be settled until after a fresh journey. The valley of the river Lakor would certainly offer a convenient road into southern Tibet and the regions in which Nain Singh's great lakes are situated.

Fig. 94. CAMP CIX; SOME BEACH-LINES FAINTLY VISIBLE ON THE EASTERN SIDE OF THE VALLEY.

As for the view northwards from the same encampment, I noted the following outstanding features as framing in the deepest part of the depression, and reproduce them on an accompanying sketch. To the N. 32° E. appeared an interval corresponding to Littledale's latitudinal valley. The lake stretches from the same quarter towards the N. 10° E. In the N. 6° E. rises the peak which I have designated Ö2. In the N. 4° W. is a gap between two conspicuous upswellings, of which the southern bore N. 19° W.; while in the N. 41° W. was a pyramidal summit and in the N. 64° W. the latitudinal valley that we were about to travel up. South of its termination lies the eastern fork of the range which ran close past our camp on the west. It was on this range that we measured the beach-lines. It subsequently turned out to belong to a range of moderate elevation that runs towards the west. South of it is the end of a smaller latitudinal valley, upon which several

glens open out from the west, south-west, and south. Its eroded watercourse has been obliterated, and disappears before it reaches the gypsum area. South of Camp CIX rises an almost free-standing butte, which, I have no doubt, is nevertheless connected with the range that forms the left-hand, or south-west, boundary of the valley of Lakor.

From Camp CIX, with the help of two of the Cossacks, and my levelling- tube and tape, I made a levelling of the mountain-slopes that rise west of that camp, my purpose being to ascertain the elevation of the highest visible beach-line above the bottom of the valley. We made our start from the edge of the level, though lumpy gypsum area, and, as I have already said, I estimated *its* altitude to be 2 m. above the surface of the existing lake. Our starting-point was situated at least one kilometer from the lake shore. The tube was fixed at 1.50 m. above the ground, so that each successive station up the slope means an increase in elevation by that amount. The distance between the stations was measured with the tape, and decreased pretty constantly as we ascended and as the ascent increased in steepness. The sketch (Pl. 27) shows along the measured line a number of irregularities with a steeper pitch; these are to be ascribed to the beach-lines.

The distance between our starting-point and the first station amounted to 198 m., that is to say we had to advance nearly 200 m. in order to ascend 1 1/2 m. The next two sections measured 56 and 61 m., then the distance dropped to 35, 16, and 13 m., then increased to 20.7 and to 19.1, but after that remained pretty constant at 10 m. or a little over all the way to the foot of a small eminence, which we left on the right. After that however the distance grew as short as 8, 7, 6, and 5 m., and during the last piece of the way it kept between 3 and 4, sometimes 5. The very shortest distance in which there was a rise of 1 1/2 m. was 3.12 m. The highest point at which the last indications of ancient beach-lines were visible lay just below or on the 50 m. distance-line from a bed of quartzite that pierces the loose detritus. The number of stations was 85, so that the last or 85th station lies 130.5 m. above our starting-point, or about 133 m. above the then existing level of the lake. The line of measurement ran towards the S. 67° W., towards the summit of the fork. Along this line we passed five beach-lines, all quite distinct, though in point of distinctness they will not bear comparison with those on the mountain-slopes at the east end of the depression. At the highest point on this western end we detected no signs of an ancient beach-line; but I continued my measuring that far, so as to ascend to the same altitude as the highest of the beach-lines at the opposite end of the depression. Thus the highest visible strand-rampart at the outlet of the valley lies at an altitude of 133 m. above the lake.

We have now therefore to compare the two opposite slopes. The outlet of the valley falls with extreme gentleness northwards towards the southern shore of the lake. On its eastern or right side the valley slopes towards the west, and on the opposite side, that up which we made our measurements, it slopes towards the east. This circumstance is of radical importance, and indeed it is obvious at the first glance; for the beach-lines which occur on the westward-looking versant are incomparably better developed than those on the eastward-looking versant; and this law holds

good, not only for the slopes which we are now considering, but for all others in that same region. The accompanying coloured plate (Pl. 26) will give an idea, half in perspective, half schematic, of the view which we obtained from the highest point that we reached of the opposite slopes around the outlet of the valley. Owing to the deep shadows the beach-lines which fell within them came out with extraordinary sharpness like black cornices, horizontal and as straight as if drawn with a ruler. On that part of the slope which lies nearest to the lake we counted eight beach-lines, though the three lowest are quite short. On the southern section of the same versant we observed seven, forming the immediate continuation of the preceding; though the same individual beach-line may be differently developed in different parts of its circuit, owing to the nature of the ground and other local circumstances. Below the lowest of the seven lines the slope is everywhere streaked with a number of similar lines, though much more faintly indicated; seen from a distance they bear a certain resemblance to the characteristic sheep-tracks often seen on the grass-grown slopes in the vicinity of the nomad encampments.

Of all the beach-lines which I have mentioned, the highest is the most strongly developed; it runs like a black protracted line all along the face of the mountains, right away to the hard rocky buttress in the S. 83° E. Below it come two smaller lines; but the fourth from the top is especially big, though not so dark as the highest one, the reason being that the slope there is not so steep, so that it lies partly in the shade. It is the highest line of all that corresponds to the 85th station in our levelling, and consequently it is situated 133 m. above the existing level of the lake. Nor is there anything surprising in the varying degrees of energy with which the different beach-lines are indicated; more surprising is the successional order which distinguishes them in this respect. One would have expected that the highest lines, in consequence of their greater age, would have been more seriously attacked by wind and weather, and consequently would be less conspicuous than those below them. But instead of that we find, that it is the highest which is the most strongly developed. Since now this line runs about half-way up the slope, one would expect to find above it at all events faint indications of yet older beach-lines. But the beach-line in question divides the slope into two sharply differentiated sections. It is only the slope below it that is scored with beach-lines. These circumstances point unmistakably to the conclusion, that the highest line must mark the level at which the lake was maintained constant and unchanged for a long period of time. At that period the Lakor-tso covered an incomparably greater area than it does now, and it belonged, I dare say, at any rate in part, to the same category of lakes as the Tschargut-tso and the Naktsong-tso, that is to say, it had rocky and picturesque shores, rocky peninsulas and islands, and of course a very much greater depth than is probably to be found to-day in any single Tibetan lake, unless we except perhaps the Tengri-nor; though I doubt very much whether even that is deeper, seeing that it lies in a relatively flat basin. Thus during the last few days we had been marching over an old lake-bottom, and the latitudinal valleys that we there made acquaintance with were formerly deeply penetrating bays of the lake. In the valley in which Camp CVIII was situated the strand rampart was at a considerable distance from the shore. There was there no beach-line corresponding to that which I have

considered as the highest. This I ascribe to the fact, that it is situated lowest down in a part of the valley which has been relatively more exposed to erosion and inundation. At Camp CIX we found big expanses of gypsum and a number of strand-terraces; but these have been caused by more recent positions of the lake; yet even the lower part of the outlet of the Some-tsangpo valley, which issues just there, has a bay pointing towards the east. There was also another similar bay in the lower part of the *thalweg* of the river Lakor, and it has there left deposits of gypsum behind it. This last penetrated towards the south-south-east, and at the period in question this lake had a very extraordinary shape, in that it resembled a hand with outspread finger-like bays, or a star-fish with its arms radiating in every direction.

The highest beach-line was thus formed at a time when the climate of Tibet was distinguished by its great constancy, and when the precipitation was so steady that the lake was subject to no fluctuations of level. Hence the wave-action, which both intrinsically and as a consequence of the greater extent of the lake, was able to engrave much deeper effects not only upon the hard rock, but also upon the disintegrated material of which the shelving acclivities are composed. If the slopes which at that period plunged down into the lake ever did bear signs of yet higher levels, they have since then been so long exposed to wind and weather that any such signs were completely obliterated before the lake began to fall in the constant way shown by the lower abrasion-lines. Add to this, that the great extent to which the lake then spread out, as indicated by the highest beach-line, is a proof, that the precipitation was at that time much more copious than it is now, and the direct erosive action playing upon the mountain-slopes was thus much greater, and this will in a measure have contributed to the destruction of any beach-lines that may have existed. All these things explain why above the highest beach-line we failed to discover any others of a similar character.

Since that time the lake has dropped, though not with absolute regularity and uniformity; for had that been the case, the abrasion would at the most have only polished and smoothed the slopes, without leaving any beach-lines, or rather the successive abrasion terraces would imperceptibly have merged one into the other. The subsidence of level from the highest beach-line downwards took place relatively swiftly, so that there is an appreciable interval between that beach-line and its next highest neighbour. The latter is comparatively slight, and thus is indicative of a shorter continuance of level at that altitude. At the fourth line the lake would again appear to have maintained itself for a very long period of time. The beach-lines which come below that are all distinctly marked, though nothing like so energetically as at the highest stage and the fourth. The breach of continuity between the eight beach-lines to the left and the seven to the right has been caused by a hollow in the mountain-slope, in which erosion, and perhaps also avalanches of gravel, have produced more conspicuous effects.

There exists one great and obvious difference between the eight upper beach-lines and the great number of others — we counted fifteen distinctly — which exist below them. The former are very prominent, the latter but faintly indicated, so faintly in fact that they can only be distinguished with difficulty. This proves that

the desiccation of the climate has advanced much more rapidly of late than it did formerly. During the period which resulted in the creation of the eighth beach-line the lake maintained its level for a relatively long period; but since then it has stood at each successive lower level an increasingly shorter period, and consequently has not been able to incise more than faint marks on the acclivities which surround it. The whole of the bay which penetrated up beside the mountain on the versant of which these lines are indicated is now entirely dried up, except for a slight remnant, and the no doubt very shallow basin of the lake that still survives will assuredly in due time disappear also. Of course there may have been oscillations, in the course of which the lake will have risen to one of the older beach-lines, but on the whole these indicate that the lake has been constantly shrinking, and this process became all the more pronounced in proportion as it dropped from the higher to the lower levels, the rate of subsidence having progressively increased. Although the higher beach-lines were thus for a longer period exposed to the influence of the weather, nevertheless in consequence of their great development they possessed so great a power of resistance that even to-day they are incomparably bigger than those which lie below them.

From the line at 133 m. we enjoyed an excellent general view of the north-western, western, and southern parts of the Lakor-tso, though we were unable to see its eastern section, owing to its penetrating into the lowest part of the great latitudinal valley. The northern and western shores are in general more mountainous than the eastern and southern. On the west side in especial the mountains plunge down steeply into the lake, although even there they leave room for a narrow strip of shore between their own foot and the existing water-line. That strip is of a white colour, and sends out capes which bore (from us) N. 35° E., N. 39° E., and N. 41 1/2° E. To the N. 49° E. we noted the promontory that juts out from the mountain with the beach-lines. The parts of the lake that were then visible to us extended from N. 9° E. to N. 63° E. The mountains exhibited tints of reddish yellow and brown, which, when contrasted with the white of the gypsum and the green waters of the lake, imparted a great richness of colouring and variety of effect to the entire scene; while above the whole stretched the vault of the sky, light blue and without a speck of cloud to mar its purity. And yet, in spite of this freshness of colouring, the scene was strangely chilly, lifeless, and desolate.

I would recommend any future expedition, that may be sufficiently equipped to admit of its making a prolonged stay in this region, to map in detail the basin of the Lakor-tso and determine by accurate measurement the positions of the old abrasion-levels and beach-lines. A map on which all these concentric lines are entered would give an especially clear idea of the shrinkage of the lake and of the variations of shape which it has successively undergone. Yaks only ought to be taken, and the visit should be made in summer, when the grass is ripe.

In my note-book dealing with this part of Tibet I have written on 21st Oct. the following sentences: »During this day's march it was plain to see that on all the slopes facing west the beach-lines and abrasion-terraces are much more strongly developed than they are on the slopes that face east, where, especially on the very soft material, they are not at all noticeable. On the slopes that face north or south

Lumst. A. B. Lagrelius & Westphal.

LOOKING N. FROM CAMP CIX. GYPSUM PYRAMIDS.

they are only moderately developed. As this arrangement seems to be the rule, the question naturally arises, what can be the cause of this? The answer is obviously, the same cause that is operative to-day, namely the westerly wind, which is prevalent during the greater part of the year, or at all events during the colder half of it, and which blows with the regularity of a trade-wind. Under this constant and violent west wind the waves of the lake are driven against the eastern shore, where they are unceasingly active, filing, washing away, and abrading the shelving acclivities and rocks that dot the shore-line, the whole weight of the lake beating as it were upon them; whereas the western shore is sheltered behind big mountain-masses, so that there the effects of the westerly trade wind are almost entirely neutralized. The northern and southern shores are also exposed to the action of the waves, though in a less degree than the eastern. But since there do exist beach-lines and terraces, still distinct, on the west, as for instance above our Camp CIX, though in comparison with those on the opposite slopes they are very slightly developed, their existence proves that other winds besides those from the west do sometimes prevail, and may possibly even be specially characteristic of some other season of the year, say early summer.»

By means of a detailed investigation such as that which I have just indicated it would be possible to determine with almost mathematical certainty the relations which the east and the west winds hold with respect to one another, that is the percentage of all the winds visiting that region which blow from the east and from the west respectively; and the result would go to show, I feel certain, that the latter are, both as regards frequency and as regards strength, far superior to the former. It would of course be essential to compare the beach-lines at identically the same level, although it is scarcely conceivable that the proportion between the winds from the different quarters can have in the slightest degree changed during what is, geologically speaking, the short period in which the lake has been subsiding. From that point of view the percentage would no doubt be the same at every level that is indicated by the successive beach-lines. And considering the accentuated character of the physical geographical features which distinguish the whole of the Tibetan highlands, that vast upheaval of the earth's crust which is bordered on the south by tropical lowlands and a warm ocean, it is very reasonable to suppose that the wind has not changed in such a relatively brief period as that, even though the moisture of the atmosphere and the precipitation have both diminished during the same period, as they naturally have done in consequence of the lake's own shrinkage. It is self-evident, that we should arrive at erroneous conclusions, if we failed to investigate and compare together beach-lines at the same absolute altitudes; for, as we have seen, lines at different elevations above the lake have reached different degrees of development, so that one line will indicate the level that was maintained by the lake for twice, or even several times twice, as long a period as another line. But one thing there is that does not admit of a shadow of a doubt, both here and in other parts of western Tibet in which I observed similar beach-lines, and that is, that even at the period when the lake stood at the 133 m. level, the westerly winds blew with a frequency that was incomparably greater than all other winds put together.

And even with regard to the power of resistance possessed by the abrasion-lines and abrasion-terraces that do survive, the wind still continues to play a not unessential part. At the present time the slopes facing west are in a far higher degree exposed to the effects of deflation and corrasion than those that face east, because the latter lie sheltered against the predominant westerly wind. So far as this influence is concerned therefore, the latter are more likely to be able to defy the tooth of time than the former, which are incessantly subject to its attacks.

If we were to follow one of the best marked of these beach-lines all round the lake, as well as we could, entering into the valleys, creeping along the mountain-sides, and skirting round the rocky promontories, and so describing an extremely irregular figure, we should certainly find everywhere abundant and convincing proof, that the line is sharper and more distinct in the east than in the west; all the same we ought not to forget, that formerly the difference was probably much greater than it is now, because the mountains on the eastern side of the lake were then directly exposed to the filing of the wind, while the mountains in the west were sheltered from it. And if we confine our attention to the beach-lines which I have recently described on the slopes of the mountains that rise east of the gypsum area, and bear in mind that those same beach-lines decrease in size from above downwards, in consequence of the increasing acceleration in the desiccation of the lake, we are justified in concluding that the difference in size between the upper and the lower beach-lines was greater formerly than it is now; the reason being, that the upper beach-lines are in a higher degree than the lower directly exposed to the wind, which strikes them at a level at which its progress is less impeded by friction with the surface of the earth. The lower the lines lie, the greater is the protection they derive from the mountains in the west, which break the force of the westerly wind. Thus it is not only time *per se*, but also the varying power which the wind exercises at different altitudes, that tended to make the upper beach-lines formerly much more pronounced and much more developed than the lower ones, beyond what the different sizes of the several lines themselves suggest at the present day.

We have found that the uppermost beach-line is bigger than any of those below it, and have assumed that this points to the lake having maintained a constant level during a relatively long period. But there is yet one other factor which ought not to be entirely neglected when we proceed to compare the different abrasion-lines one with another. When the lake stood 133 m. higher than it does now, the relative altitudes of the surrounding mountains were of course 133 m. lower than they are now. The surface of the lake was consequently then in a far higher degree exposed to the wind, which had in this locality freer play and was less impeded by the relief of the mountains. Independently of the area of the lake, the beat of the waves was therefore both higher and more powerful than it is now, when the lake lies lower and better protected in its deeper basin. Then to this we must add the greater area of the lake, a matter of prime importance in determining the height to which the individual waves rise. When the lake was 133 m. higher, its area would be several times greater. The breadth of the valley outlet, in which stood our Camp CIX, was then at least twice as great as that of the southern bay of the existing lake. Let us say that this would double the abrasive power of the waves,

and that that power was again doubled by the level of the lake being 133 m. higher. *Ceteris paribus* therefore the abrasion-terrace, which the waves are now creating on the western shore of the promontory visible to the N. 49° E. (see the coloured plate) ought to be only about one-quarter as big as that situated at the 133 m. level.

All I desire to say is, that it would be wrong to make time and the constant position of the lake exclusively responsible for the circumstance that, *e. g.*, the highest beach-line is the most developed; because the additional circumstances, that the wind was then stronger than it is now by reason of the smaller friction, and that the beat of the waves was higher by reason of the same cause, as also by reason of the greater area of the lake — these circumstances account to no slight extent for the greater development of the higher-lying terraces. In other words, apart from the disintegration and corrasion operative at a later period, the abrasion-terrace that is now being created at the western foot of the recently mentioned promontory would require at least four times as long a period to become as much developed as the 133 m. line, or in other words, the lake ought to remain at its present level at least four times as long a period as that in which the 133 m. line was formed.

To sum up. These old beach-lines offer incontrovertible proofs, that the Lakor-tso is shrinking and contracting, and is advancing to meet the same fate that has overtaken many of the lakes which we encountered subsequently, that is to say, it will dry up completely. In each and every one of these energetically marked beach-lines we have as it were a distant »fossilized» echo of the song which the waves once sang when they beat themselves against its rocky shores. With the help of the perspective that they open out, one can adumbrate a distant past in which the physical geography of Tibet was in essential particulars different from what it is now. Orographically the country has since then undergone no other change except that which has been occasioned by the still progressive disintegration. But the number of lakes was then greater, and each separate lake was of greater size; the rivers carried down fuller volumes to this self-contained basin, the precipitation was more abundant, white-robed rocks commoner, glacier arms, which are now rare as well as rudimentary, were then general, and descended lower down into the valleys, and, as a consequence of all this, the erosive energy was as a rule more active than it is at the present day. In the levelling of the highlands water played a more important part than it does now, for at the present time it is the rending power of the frost, insolation, and wind which in combination continue to counteract the formation of mountain-ranges, while aqueous erosion plays but a secondary rôle. On the other hand, as I have already suggested above, the wind does not appear to have altered since then its characteristic properties; for at that time also the prevailing wind blew from the west. But the sky was more frequently and more heavily clouded, hail and rain showers smote more often upon the bare mountain-sides, and the earth was, I feel sure, not seldom covered with a connected sheet of snow, though snow is now an infrequent sight, at all events it was so during the autumn and winter of 1901.

CHAPTER XII.

FROM THE LAKOR-TSO TO THE BONDSCHING-TSO.

From the highest point that we measured we continued along the foot of the mountains until we came to a little flat col (4,688 m.), forming a water-divide between the Lakor-tso and quite a small lake, intensely salt, situated immediately west of it, and according to my aneroids at an altitude of 4,572 m. On its southern shore two broad gullies intersect one another, and upon them open out a number of transverse glens which cut their way through the southern range. These two gathering gullies are separated from one another by a ridge running north and terminating at the lake in a free-standing, conical mountain, which goes down abruptly into the water. The shores of the lake, with the exception of that on the west, are mountainous, and where flat they, like the corresponding shores of the Lakor-tso, are white with deposits of gypsum, and the water has the same beautiful, pure green tint. After crossing over the second gully, we reached the shore, which we were forced by a steep headland to follow for a short distance. Hence we obtained a good view of the little lake, which is as usual elliptical in shape, with its long axis stretching from east to west. On its northern shore rises a not inconsiderable mountain-range, the western section of which is reproduced on Plate 29 To the N. 59° E. towered up the peak A3, and behind it, to the N. 61° E. another, belonging to a higher and more northerly range. The strip of level shore is broader in the north-east and gleams white with gypsum. Along the line of continuation of the lake towards the east there is a very low pass, separating this lake from the adjacent Lakor-tso. The acclivity from the eastern shore of the lake up to this little pass is moderately steep, and on the slopes facing west there are again some strand-terraces, indicated with great sharpness and distinctness.

After skirting round the headland, we marched up a rather steep transverse glen, which there debouches upon the lake, and approached a small and in every way secondary pass, and then on the other side of it descended into a similar transverse glen, in the lower part of which we made Camp CX, at an altitude of 4,596 m., that is not very much higher than the lake.

On the declivity leading down from this little pass the old strand-terraces, although situated in detritus, but detritus that is still fairly hard and consolidated,

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are again very beautifully formed, being arranged along the sides of the glen with the regularity of the rows of benches in a circus. On the eastern declivity going down from the same pass there are, on the contrary, no ancient beach-lines. Thus we have here again a fresh proof, that the west wind prevailed also in ancient times: the western versant was exposed to the wind, whereas the eastern versant was on the leeward side. On the next mountain-wall, west of the camp, which was rather steep, the ancient terraces show up with especial distinctness when seen in profile (fig. 95).

Fig. 95.

As the water-dividing col which we had just crossed over lies only 100 m. above the Lakor-tso, but the highest beach-line lies 133 m. above the lake, the two lakes must formerly have been connected at this point. And the same thing would obtain, though with all the greater certainty, at the considerably lower pass which we observed immediately east of the lake. Hence the two detached mountains which stand between these two cols will at one time have been islands. At that time the little lake, which the Tibetans called Dschivu-tsaga, extended a good long way towards the west, the latitudinal valley in which it is situated being especially flat in that direction. From the same point we had to travel a long way west before we again found ourselves at the same level as the highest abrasion-line overlooking the Lakor-tso. Camp CXI, though it was indeed not very far from Camp CX, lay, according to my hypsometrical instruments, only 5 m. above the level of the Dschivu-tsaga. And we discovered abrasion-terraces to the west of Camp CXI. At the time when the 133 m. level was being carved on the mountain-side the conjoint lake must therefore have had an especially peculiar and complicated shape, reminding one of the Tschargut-tso. Two or three of the mountains that now stud the shore of the Dschivu-tsaga were then circular islands, situated quite close to the shore. What remains of the once huge lake is now divided into two very salt basins, circular or oval in shape, with more regular and less indented shores, thus approximating to the conchoid type of basin that is characteristic, for example, of the Selling-tso.

The country around Camp CX was fairly interesting. At the foot of the southern mountains, which approach quite close to the lake, a copious spring gushed out, yielding a bright rivulet of the most beautiful water, and this trickled along between grassy overhanging banks. The ground was sandy and the grazing good, at all events better than any that we had come across during the last few days. At that meridian the lake has already come to an end, and is continued westwards by a flat gypsum area. But in the same locality, just below the camp, the rivulet empties into a pool, and north and west of it there are one or two similar pools. Around these were big flocks of gulls, a circumstance pointing to the water being fresh, at any rate in places, or only slightly saline. Strange to say, in this short, steep brook, in which cascades $1^1/_2$ foot high are by no means uncommon, fish were swimming about; so that the spring which feeds it will flow all the year round. The prospect north and north-west, where the immense gypsum expanse lay, was however the

most interesting. Here again we perceived the same conical and pyramidal elevations and irregularities which I have mentioned as characterizing the gypsum area round the shores of the Lakor-tso. Here however there are others that resemble terraces and platforms, that is to say they are level or but gently undulating on the top. Elevations of this kind occur between the pools which I have just spoken of; in fact these pools are very irregular in shape, for they thrust out »fingers», bays, and sounds between the gypsum platforms. In the west the lake is remarkably shallow, and after that it changes imperceptibly into a barren salt marsh, the gypsum and water gleaming respectively white and light green. The little pass which we climbed over just above the camp is situated in a spur of the southern mountains; these

Fig. 96. THE GYPSUM AREA WEST OF THE SALT LAKE.

rise close to the lake into a detached conical eminence built up for the most part of loose material. Its summit and its northern headland are the only places at which hard rock crops out, and the headland plunges sheer into the lake, or more correctly into a marshy strip of shore beside it. This piece of marshy ground was so soft that it refused to bear even a man on foot, and it was for that reason that we had to make the detour over the little col. To the west we saw no pools in the gypsum area; the three which I have alluded to are maintained by the brook. The marsh at the western end of the lake keeps drying up progressively in proportion as the lake shrinks; thus the expanse of gypsum is constantly advancing towards the east, and in the relatively near future the little lake will entirely disappear.

The spring is said to be called Dugdschu-türpab and the mountain-range south of the lake of Dschivu-tsaga is known as Segor.

On the slope on which we measured the beach-lines we found a dark, fine-grained crystalline schist, dipping 83° towards the N. 12° E.; at the highest point

on the same slope was quartzite, with a dip of 80° N.; just beyond the first col the same crystalline schist was visible, dipping 68° towards the S. 58° W.

The lake lies 4,572 m. above the level of the sea. Thus in the region around the two salt lakes we had been moving 200 to 300 m. lower than usual on the Tibetan highlands. At the time when the lakes lay 133 m. higher than they do now, this region did not possess in so conspicuous a degree the character of a depression. Once or twice subsequently we came across circumstances that are in every respect the same. And indeed it is evident *a priori* that so it *must* be, for it is only in the depressions of the highlands that salt lakes occur, and they gather into the lowest part of each self-contained drainage-basin. But in proportion as the salt lakes dry up, the more pronounced becomes the character of the actual depression. When your aneroids and your boiling-point thermometers continue for the whole of one day's march or longer to indicate a constant downward inclination of the surface, you have every reason to expect a fresh salt lake.

On 22nd October we made a very short stage towards the north-west, along the foot of the southern mountains and in part across the gypsum area. We only covered a distance of 4.4 km., and then came to good grazing, better, according to our Tibetans, than any we should find for several days to come. Having gone down from the brook to the foot of the mountain, we then had close on our right in part a barren marsh, in part some other small pools, covered with strong ice, that would bear, and containing water that was almost fresh. These pools hardly seemed however to have any connection with the spring-fed brook, but rather to be fed by independent springs, which emerge within them, and out of them the water proceeds to the marsh and the lake. It is only at the foot of the mountains that any grass grows; otherwise the bottom of the glen is white and sterile. The pools and lagoons which I have mentioned are often bordered on one or more sides by vertical terraces of gypsum; but these generally belong to insular platforms with level tops. When you look at them from a low point *au niveau* with their surface, their superficial contours melt together into a perfectly straight line. Between them you see the usual gypsum mounds, indicating the places in the gypsum deposits in which erosion has advanced farthest. These mounds are seldom 3 m. high. On the other hand I can hardly say that there is any increase in the height of the mounds to be observed from east to west: the mounds in the west, which have been exposed to wind and weather for a longer period, and consequently ought to be more severely attacked and modelled out by erosion, are not apparently any higher than those in the east, which were exposed at a later period; for even though erosion does deepen them at the bottom, the wind planes them away on the top at an equivalent rate, and the result is, that no perceptible difference of elevation can be detected between those in the east and those in the west.

After travelling for a couple of kilometers across this extraordinary gypsum formation, we approached a little brook coming from the west, and making its way across that area towards the western shore of the lake, though it does not appear to be able to reach it, but dwindles away amongst the gypsum elevations. A little below the point where it ceases, we observed one or two rivulets trickling from the westernmost of the marshes, and they no doubt derive water from this brook after

rain. Leaving the brook to the south, behind a free-standing gypsum hill, we crossed over another watercourse, then dry; this comes from the north-west and unites with the first brook at a point where the latter sends a little branch to the north, which then gives rise to a round isolated lagoon. It was just beyond this point that we pitched our tents for Camp CXI, at an altitude of 4,577 m., or only 5 m. above the level of the lake. A very slight rise therefore in the lake would result in considerable areas of the bottom of the latitudinal valley being flooded.

Fig. 97. OUR YAK CARAVAN.

On the nearest promontory to the south the quartzite cropped out at 31° to the S. 30° E. The sp. gr. of the water in the little lagoon was, by the areometer, 1.0005. At this place I was given the following names: the nearest minor mountain on the south is called Ju-divu. Luma-nagma is a locality lying north-west of our camp. A mountain to the south-west, slightly sprinkled with snow, was called Marmi-gotsang, and on the south side of that mountain there is a temple known as Marmi-gombo, at which 300 or 400 lamas dwell. And we had unmistakable evidence that there was a temple there, for we repeatedly heard trumpet-blasts from that direction. Time did not allow me to pay it a visit; besides our Tibetan escort were very strenuously opposed to any such proposal.

A hard wind from the west as usual; this time however it did not blow so steadily as at other times, but came in frequent gusts. As a general rule it was, I should say, stiff for 2 minutes, and then for one minute its force was that of a hurricane, and after that there would be a couple of minutes slackening, and then the next gust would follow. Sometimes however 4 to 5 minutes would intervene between the more violent gusts; the latter repeatedly threatened to blow our tent over. Next night there was not, as usual, any cessation in the wind, and it continued to blow

three parts of a tempest all the following day. At times we had to go on foot to prevent ourselves from getting frozen. When you walk in such a gale along a moderately steep slope, it is as if you were walking on the level ground, and when you walk on the level ground, it is as if you were struggling up a slope. In the teeth of such a wind both horses and camels advanced laboriously, their efforts proving a great drain upon their strength. Had we only been travelling east, what a help it would have been to us! At about 4.30 p. m. the gale abated, though it still continued to blow at the rate of 14.3 m. in the second; but occasionally there came brief gusts with fully twice that velocity.

Fig. 98. OUR YAK CARAVAN.

Plate 29 reproduces the western half of the range which borders Dschivu-tsaga and its level latitudinal valley on the north, the scene being that which we beheld from Camp CX. To the N. 18° E. rises a commanding peak, and to the N. 19° W. the extreme western peak of the range. This chain consists for the most part of rugged hard rock, and has a gravelly scree stretching from its foot down into the valley. From Camp CXI the range is seen foreshortened, its extreme westerly peak bearing north-north-east. Beyond this range to the north there appeared to be another latitudinal valley, not very broad however; but the route which Littledale followed, and which we had all the time on our right hand, seemed to lie along a valley still farther towards the north. The nearest latitudinal valley to the north of Camp CXI is connected in that same direction with the valley in which the Dschivu-tsaga is situated. The mountain-ranges which blocked our view in that quarter were not particularly high. Two routes were said to lead to the next camping-ground, and of these, the more northerly one, which crosses over a pass, is the shorter; but the other, to the south, does not cross any pass. I chose

the latter, and it led us west-south-west over gently rising ground. The range that borders this valley on the south is of fair size. In one place it is low, and there a transverse glen leads up to a convenient pass, whence one of my scouts observed a fresh latitudinal valley to the south, running parallel with the one in which we then were, and with a perfectly level floor. The scouts saw only one tent, but nothing of the temple.

Fig. 99. THE LATITUDINAL VALLEY.

On the slopes close to our left we still continued to observe strand-ramparts, very distinctly marked, and we observed them moreover on the slopes that are relatively more exposed to the west. But in point of development these could not in any way be compared with the abrasion-terraces which we had seen on the eastern shore of the Lakor-tso. The reason of this is, quite naturally, that here in the west they have not the full sweep of the lake beating upon them, but only a small portion of it is at the mercy of the wind; hence the beat of the waves is quite insignificant. All the same, it has been sufficiently powerful to give rise to terraces, and these possess sufficient powers of resistance to have prevented their own complete destruction. The ascent increases in steepness all the way from the point where the terraces cease, and where the lowest of them dies away into the flat shelving at the bottom of the valley, and we then marched at elevations higher than the 133 m. curve. Consequently we saw no more strand-ramparts or beach-lines. There were none perceptible on the eastern face of the bluff that we next travelled round in a north-westerly direction; hence that side of the bluff has been completely sheltered.

The latitudinal valley continues to stretch towards the north-west and grows narrower. Its floor is hard and comfortable for marching on, with but little grass or none; nevertheless there were great numbers of kulans. The big range on the

Fig. 100. ROCKY PROMONTORY WITH THREE SHEEP-FOLDS.

left possesses some upstanding peaks, with a little snow on them, and sends out steep offshoots and ramifications towards the north-east. Such snow as there was lay almost exclusively on the west side of the range, whereas the eastern flanks were quite free from it — a circumstance dependent of course upon the prevailing wind. That snow was, I dare say, a survival from the latter half of the rainy season, when the precipitation in that lofty region comes down for the most part in that shape. There is no perpetual snow there, and in the early summer all the mountains in that region will pretty certainly be free from snow.

Fig. 101.

After that the latitudinal valley assumes quite a different form from what it had hitherto had, in that its bottom becomes divided into a number of small self-contained basins. We came to a threshold, but so flat was it that we only knew it was such by seeing the erosion watercourses on its western side gathering into a very shallow depression, the bottom of which was then occupied by an expanse of level, dry, yellow clay; this is manifestly converted into a miniature lake after rain. The altitude was 4,751 m. Farther on we passed yet two other similar clay expanses, separated from one another by imperceptible swellings. Otherwise the bottom of

the valley is rather broken; its lowest part lies next the foot of the mountains on the north, and it is there too that the three clay depressions are situated. Generally the profile of the valley is like that shown in the accompanying sketch (fig. 101).

At length however we approached a definitive pass, at an altitude of 4,866 m., and on the other side of it a total change takes place in the orographical structure. To the north-west appeared a very extensive expansion, with several big valleys opening out upon it. From the pass the surface falls more quickly towards the north-west and north-north-west. We next doubled a projecting rocky promontory on the right, and crossed over a couple of dry watercourses, containing a little water, the altitude there being 4,766 m. There too we lighted upon three Tibetan tents, with big herds of yaks, although the pasture was very thin. That locality is said to be called Schagbo-sadschu, and the brook Schagué-tschu. The latter contained some small fish.

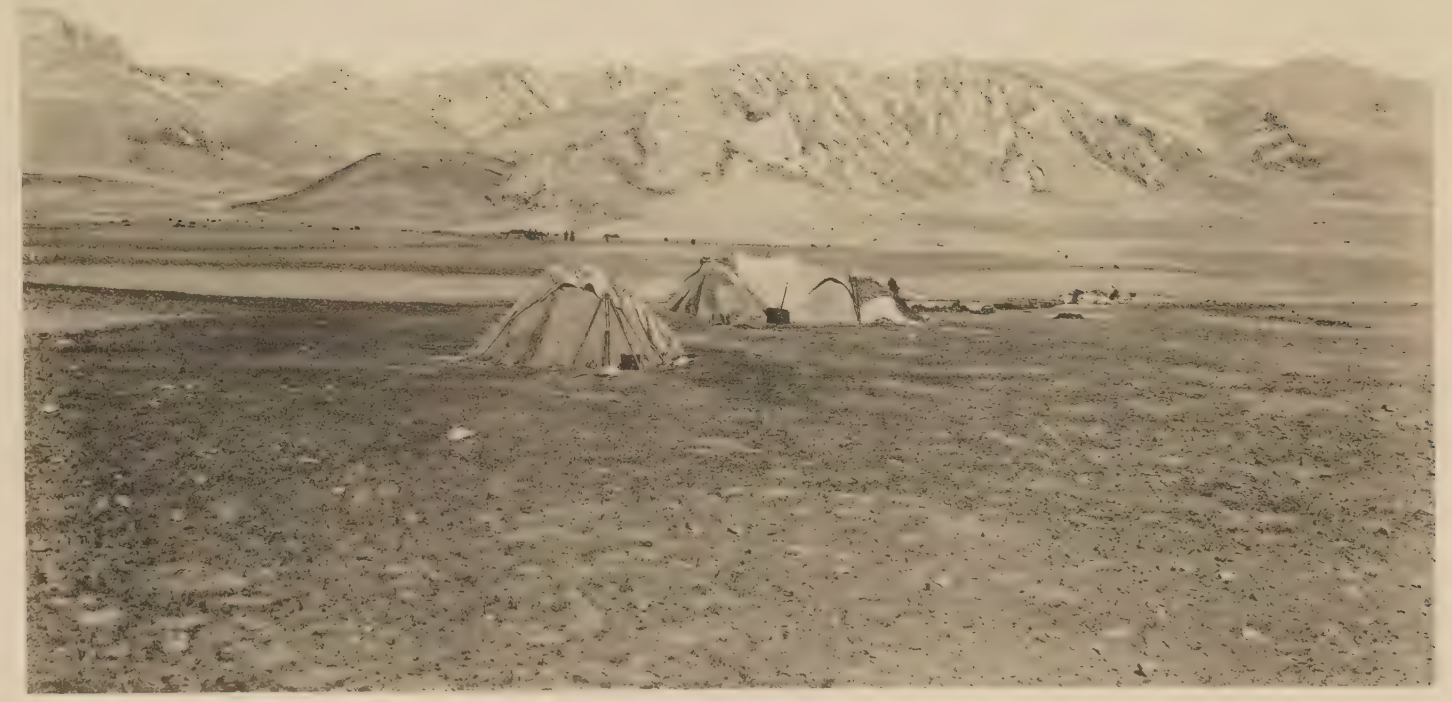
Fig. 102.

At the present time this region is not inhabited; but that the nomads do graze their flocks and herds there at other seasons, probably in summer, was evident from our passing no less than four sheepfolds, the usual semicircular stone walls, in shape like a sickle and open to the east. Three of these stood quite close together, as the accompanying illustration (fig. 102) shows, and that immediately east of the first level clay expanse. From this it is evident that there are springs to be found somewhere in some transverse glen in the locality, or else water is obtained from the pools which collect in the hollows in the late summer, and which may of course contain fresh water.

Near the place where the three sheepfolds stood the rock was quartzite, dipping 72° towards the N. 39° E., and at the point where the latitudinal valley expands was a fine-grained granite, bedded 66° towards the N. 60° W.; it projected out of the detritus in the form of slabs and cornices. Similar projections are common on the slopes, although the mountains and hills on both sides of the valley generally exhibit soft, rounded outlines. The crest of the southern range consists however predominantly of bare, ragged crags.

October 24th. The brook at Camp CXII is formed by springs that issue close at hand in the bed of the main stream; but above them the bed was dry. The rivulet died away in the gravel not very far below the camp, so that it was amazing how fish could live in such a short and scanty current. However the dry watercourse ran on farther towards the N. 73° E. down another latitudinal valley, evidently parallel to the valley in which we had been travelling. The new valley is undoubtedly connected in some way or other with that which we had observed north of Camp CXI, and possibly it belongs also to the hydrographical area of the lake of Dschivu-tsaga, although there is no warrant for this in the descriptions which the Tibetans gave me. Possibly the watercourse which traverses it terminates in some smaller, independent basin north-west of the last-named lake. In this region there were great numbers of partridges; but the only wild animals were kulans, and they too were numerous.

During this stage we were of necessity compelled to keep to the north-west by the direction in which the mountain-ranges ran: the sweeping curve which the



Lithstr. A. B. Lagrelius & Westphal.

LOOKING NORTH FROM CAMP CXII.

Himalaya makes towards the north near its western extremity affects also these mountain-ranges of central Tibet. After crossing over the frozen brook, we ascended the gently rising surface of the open valley expansion, the ground being hard and consolidated, with the merest sprinkling of grass, and at length we reached the great range on the north, with steep and picturesque glens opening out between its separate rocky foot-hills. We also commanded a magnificent view of the southern range, though the only peak bearing snow was D3. Farther on there was no snow. This range was said to be called Garu-tse. Beyond it there is reported

Fig. 103. A SHOT KULAN.

to be yet another parallel range, which has to be climbed over before you can reach the temple of which I have spoken. From the middle of the broad valley expansion the outlets of four glens were meanwhile visible, though two of them were of course only the continuations of the others. Nevertheless the disposition of these glens is quite peculiar and unusual. In the latitudinal valley containing the three clay depressions we had marched towards the north-west. Then, having crossed over the valley expansion, we continued through a similar narrow latitudinal valley in the same direction. Orographically the latter must be regarded as the direct continuation of the former. But here the following peculiarity should be noticed, that this latitudinal valley is, as it were, intersected diagonally by another latitudinal valley, running at the point of intersection from west-south-west to east-north-east, its direction being distinctly indicated by the watercourse that traverses it. To the west it does not however continue very far. We saw its high-lying gathering-basin from Camp CXII; but it is possible that it may continue farther

west on the other side of a pretty high pass, though it will doubtless experience the prevalent bend towards the north-west, and thus become transformed into a glen parallel with the valley in which we travelled to Camp CXIII. Camp CXII was situated at the point of intersection of the two latitudinal valleys. From that spot the brook continues, as I have said, towards the N. 73° E.; but it too undoubtedly trends towards the east and south-east so as to come parallel with the valley in which are the three clay expanses. It is undoubtedly a fact, that the latitudinal valley is at first situated south of the one in which we were then travelling; a fact that at our Camp CXII it intersected the latter valley; a fact that it afterwards runs to the north of the same. In the western angle

Fig. 104. A YOUNG KULAN.

between the two latitudinal valleys there rises quite a short detached chain, stretching from east-south-east to west-north-west. It is separated from its westward continuation by a transverse glen, upon which converge all the water-courses that lie east of the pass which we were about to cross over, as also those that stream down off the slopes of the principal range to the north. They then unite into one main stream, which, after piercing the transverse glen, makes its way down into the chief watercourse of the basin, reaching it a good bit above Camp CXII.

After we left the transverse glen behind us the latitudinal valley was more energetically shaped and more closely shut in by its wild, picturesque, reddish-looking crags, with their pinnacles, pyramids, and upstanding towers. The features of the landscape were here modelled on a more gigantic and impressive scale than we had hitherto been accustomed to see them up on the Tibetan highlands.

The pass in the latitudinal valley (alt. 4,820 feet) is so flat that we had to examine closely in order to discover its culminating ridge. The range that we had here, and continued to have, close on our left for as far as we were able to see, towered up above our heads like a long row of great castles of chivalry, with crenelated walls and towers, a remarkable instance of the vagaries of nature. From the pass the bottom of the valley, still continuing narrow, inclines very gently towards a miniature lake, containing fresh water, which was then frozen. Its altitude was 4,785 m. We pitched Camp CXIII 12 m. above it and not far from its eastern shore. The scenery was fascinating, but the grazing wretched.

Fig. 105. CAMP CXII LOOKING S 9° W.

In the first isolated little range that we passed in the morning there occurred a hard, light-green schist, dipping 31° to the S. 30° E., which appeared to lie interbedded between the dense, white limestone which otherwise predominates throughout the entire region. The latter is brittle, and upon being struck fractures at every possible angle, and in the face of the fracture shows light-coloured, almost white, though otherwise it exhibits various shades of reddish yellow. On the left side of the pass this rock dipped 77° towards the N. 22° E. In the higher or northern range it appeared to incline also towards the north or north-east, if one may judge from the thick rocky ledges which the heads of the strata make as they crop out on this side. In both colour and shape they contrast sharply against the rounded slopes and gravelly screes above which they project.

During the day, and after an almost tranquil morning, the west wind was somewhat gentler than usual; on the pass the wind at times veered round even to the east. But in the afternoon the west trade-wind resumed its usual force, driving with inconceivable violence through the deep latitudinal valley, which made such a convenient conduit for it. Our Tibetans asserted, that this hard wind had been

blowing for at least a month, and that it would continue to blow for another four months; during the cold season of the year it always blows, they declared, in that same way. The fall of snow is, on the other hand, said to vary a good deal from year to year, and generally it does not begin until the winter is well advanced. It is however at no time particularly abundant. Sometimes it does fall in vast quantities, and when that occurs in conjunction with violent wind the snow-storms are apt to be dangerous for both man and beast; almost every year a greater or less number of sheep are lost in the snow-storms.

Not far from Camp CXIII there were nomads somewhere; but *where* they were our escort refused to tell us, probably they were afraid we should do their compatriots some injury. But as our Tibetans brought sheep, and also fresh and thickened milk, we understood that there must be nomads at no very great distance away.

The southern range is said to be known as Sebli, the northern as Ning, and the little freshwater lake as the Oman-tso. The leader of our escort admitted, that some years ago a Peling-bombo (European chieftain), who of course can have been none other than Littledale, had travelled the same road that we were then following. This statement is probably correct, although Littledale's own map affords no means of checking it. For example, the Oman-tso is not shown at all on that map, and yet it is of some importance, not so much for topographical reasons as because it is a well-known centre where water and pasture are to be had. It is however so small that Littledale may have considered it unnecessary to enter it on his map. Moreover it is very probable, that Littledale travelled by some other of the adjacent parallel valleys. Of the names which he records as occurring in this region my Tibetans had only heard speak of two, namely Sponjen Baptse-tso, though they pronounced it Bondsching-babtsa-tso, as also Kundor-tso; the others they knew nothing at all about. Senkor and Kamba are the names of tribes. The name Uruktuksang may possibly be a misapprehension for Rudok-tsang, or the Country of Rudok, which begins a long way to the west. I have of course no grounds, nor have I any right, to regard the names that were given to me as being more reliable than those which were imparted to Littledale. I look upon them all alike as dubious, and have no confidence in any except those that are alike in his list and in mine; as also those that were collected by Nain Singh, who was able to converse with the Tibetans more easily than either I or Littledale were. In reply to inquiries, as to whether there was not a more southerly route, the leader of our escort replied, yes, there certainly was a more southerly road through the mountains; but it was exceedingly inconvenient, as it led over several passes, which camels could under no circumstances get over; moreover the regions it traverses were not at that season visited by the nomads; you might travel there 15 to 20 days without coming across a single individual. These statements were probably on the whole correct, for we should have continuously on the south the vast swelling of the highlands which separates the region of the latitudinal valleys in which we were then travelling from the relatively lower country and the valley of the Brahmaputra on the south. It is quite conceivable that the nomads do not visit those high altitudes in the winter, for they can no doubt find better grazing farther south. Poorly inhabited

LOOKING N. 25° W. FROM CAMP CXIII.

Liustr. A. B. Lagrelius & Westphal.

MOUNTAINS ON THE SOUTHERN SIDE OF THE VALLEY BETWEEN CAMP CXIII AND CXIV.

though these regions are, they are nevertheless for administrative purposes kept separate from one another. Upon reaching the frontiers of each new province or administrative region, we were always provided with a fresh escort and with fresh yaks. The district in which we just then were is called Sagetsang, and its inhabitants belong to the Senkor tribe.

On the 25th October, in so far as the above-mentioned lake Sponjen Baptse-tso is really identical with our Bondsching-babtsa-tso, or as it is also called Bondsching-tso, we appeared to be travelling in Littledale's footsteps. It was a glorious morning, and quite still, so that I was able to photograph without running the risk of having my camera blown over every minute. The absolutely pure atmosphere, making objects visible to an immense distance, is *per se* most favourable for photographing, as will be evident from some of the accompanying plates. But at 2 p.m. the western »trade» wind again set in with full force; but, as usual, there was not the smallest speck of cloud, not even the tiniest cirrus, visible.

We still continued to travel in the same direction as before, almost due north-west. Leaving on our right the little frozen lake of Oman-tso, we ascended the gently inclined latitudinal valley, the two mountain-ranges of which approach close together, and all day presented the same rocky crests, vertical precipices down to the upper margin of the gravelly talus, and the same detached and conspicuous towers, for all the world like petrified, and in part ruined, castles of chivalry. There were no side-glens worth speaking about, only crevices and almost vertical watercourses. The only real transverse glen that we saw comes from the west-south-west, and it appeared to bring down with it the channel which becomes the main watercourse of the basin, flowing down the middle of the valley to the Oman-tso. This basin is bordered on the west by an extremely flat threshold running athwart it and only a few meters above the level of the Oman-tso. The surface falls gently towards the north-west, and the valley grows a little broader. Just past the pass two side-glens open out on the right, disclosing a view to the north and north-east, the principal features being several parallel crests. Sometimes these glimpses up the side-glens are especially picturesque and attractive — magnificent precipices with projecting terraces, on which the lights and shadows play in the transparent atmosphere with wonderful effect, and show up the outlines of the mountains in pregnant relief.

From the mountains on both sides of the expansion north-west of the pass there issue watercourses, which soon unite into one, and this then winds farther towards the north-west, keeping approximately to the middle of the valley, until finally it terminates in a flat depression, a tolerably extensive area of clayey alluvium, as level as a floor, but frequently cracked into thin cakes of clay, polygonal in shape and slightly concave. Here then sometimes no small body of water will gather, giving rise to a very shallow and transitory lake. On the other hand the main stream of the valley bears no traces of carrying a more copious flood, although it is, I dare say, occasionally visited by such. Upon the same depression debouch also a number of tiny secondary glens from each side, and in the continuation of the latitudinal valley there exists also a similar main watercourse, which rises on the pass that bounds the depression on the west. The level clay expanse

fills almost the whole of the bottom of the valley, leaving on each side only narrow strips of sloping ground belonging to the respective gravelly screes. The valley maintains the same breadth, that is to say, it remains relatively narrow and is still shut in by wild rocky crests. Neither of these however is a main range, for at intervals, especially up the often narrow outlets of the transverse glens, we saw both to the north and to the south of our route the still more imposing masses of the main ranges towering up behind them. On the whole these main ranges are less rugged in outline, but more compact and massive.

Fig. 106. TIBETAN CAMP AT CAMP CXIV.

Out of the depression, which according to my instruments lay at an altitude of 4,689 m., we ascended with the utmost gentleness to its western col, at an altitude of 4,715 m. Immediately west of the pass, and only a couple of meters lower than it, lies the little freshwater lake or rather pool of the Bondsching-tso. We made Camp CXIV not far from the foot of the southern range, at an altitude of 4,808 m. The reddish range on the north side of the valley is called Tsä-marbo; the entire region or district was still known as Sagetsang, or as some of the Tibetans pronounced the word Sagsang. On Littledale's map we have in this locality the name of Taksan, which may possibly be meant for the same as Sag-sang. But his lake of Sponjen Baptse-tso is quite 10 or 15 times too big, that is if it indicates the same pool as my Bondsching-tso.

The same rock as heretofore still continued to prevail. At one spot east of the depression its predominant dip was 37° towards the S. 30° E., but its flat

Lnstv. A. B. Lagrelius & Westphal.

LOOKING S. 60° E. FROM CAMP CXIV.

surface inclined just as distinctly 70° towards the N. 10° W. This rock possesses several systems of cleavage, and when broken to pieces fractures into small parallelepipeds. The material in the bottom of the valley was generally very finely divided, although the slopes were also in places strewn with gravel.

October 26th. The valley still continued to preserve the same characteristic features as before; it was monotonous and positively irksome to ride through these everlasting latitudinal valleys, where there is no change in the scenery to keep your interest alive. How much more instructive it would have been to have travelled from north to south, and to have found one's way across all these parallel chains, of the real conformation of which one gets only a slight and unsatisfactory idea by journeying along the latitudinal valleys! But by then there was of course no other choice open to me. Our faces were set towards the west-north-west, towards Ladak, and all we had to do was to keep riding along the latitudinal valleys which run in that direction. Moreover our animals would not have been able to make any side-excursions; indeed it was merely a small fraction of the total number that succeeded in holding out to the end of the journey and reaching Ladak. Our road this day was as convenient as could be desired, being downhill all the way to the next camp. Upon reaching the spot where the glen of Amlung joins the valley from the south we had already got down to 4,640 m.; a little bit farther on we were at 4,606 m., and our camp at night stood at 4,573 m. As usual, this regular descent presaged the propinquity of a depression of far-reaching extent.

On our left, that is the south, we now had three parallel mountain-ranges, increasing in altitude successively towards the south, and being distinctly perceptible through the outlets of the transverse glens. At Amlung especially the triple arrangement was very plain to see. This glen starts on the northern flank of the range farthest south, on which small patches of snow were then showing here and there, and then it breaks through the other two ranges, forming a steep, wild gorge, into which perfectly dry tributaries enter from both sides; in fact, dry rivulets of this character are common in that neighbourhood. We did not discover any track leading up the Amlung glen, nor could we learn that there was reputed to be any; it is strange therefore that it bears a name. Possibly there are springs higher up near which the nomads may sometimes encamp.

On our right, that is to the north, we saw two ranges, likewise running close together, and in them the rock appeared to dip generally towards the north. These were of a reddish tinge, whereas the mountains in the south are of a darker colour. From the right comes a combination of latitudinal valley and transverse glen, known as Döjka. Its upper part is squeezed in between the two parallel ranges; then it divides and in two separate places cuts its way through the more southerly of the two ranges. In the angle between the transverse sections stands an isolated mountain butte. A very peculiar and unusual form of valley! From that point we observed to the S. 85° W. a crest that was more abundantly covered with snow; this is said to be the Janak, and is, I dare say, a portion of the main range of the southern mountain system. Then, in the locality called Rigong-somdo an energetically carved transverse glen bursts out of the nearest range on the south. Our latitudinal valley was there so narrow, that the transverse glen which I have

just mentioned was even broader and more open than it. The big range lightly tipped with snow at the head of the glen is known as Tschong-re, and is again probably a portion of the main range of the southern system. Thus the middle range of the three which I first mentioned has here died away and come to an end. There was still a tiny brook flowing down this great side-glen, being fed by springs not very far away, but the rivulet very soon became lost in the gravelly watercourse of the main valley.

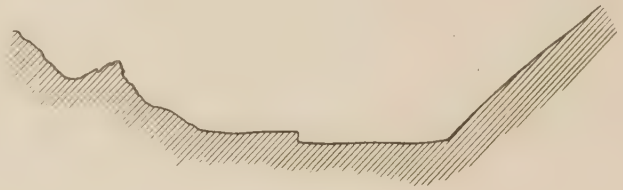


Fig. 107.

This last, which up to that point had generally had a breadth of 500 to 1,000 m., there narrows to 200 m., indeed sometimes to only 100, or even 50 meters. Thus almost the entire bottom of the valley is occupied by the watercourse, with its abrupt marginal terraces. When the channel hugs closely the one side of the valley, the terrace there often disappears and is developed only on the outer or opposite side. Partridges were abundant here. The valley, which had recently held a west-north-westerly direction, turns to the north-west, and finally merges into a latitudinal valley of a »higher» type, very broad and open, with a fairly level bottom, and bounded on the north by dark ranges and chains of moderate elevation, mostly rounded and quite free from snow. We pitched Camp CXV beside a little spring at the beginning of the new valley, but the yield of water was so niggardly that it was barely sufficient for our wants. The altitude was 4,573 m. This locality is called Regong-ka. Just above the spring we observed the same species of rock as heretofore, dipping 58° towards the S. 20° W. Of the other names given to me at this place the following may be recorded: a prominent mountain peak rising due east is called Marvo-damduk; the mountain to the north-east bears the name of Repschta; a mountainous district to the east-south-east is said to be called Nadong; the dark range on the north of the big latitudinal valley is called the Nagri-gosum; Jere-tombo is a mountainous district to the south; a little yellowish mountain to the N. 5° W. bears the name of Jombo; and another district quite close at hand is known as Tschubjuk. From what Littledale's map says, we appear during our last day's march to have followed a different valley from that which he travelled by; although it is impossible to speak with anything approaching to certainty upon this matter. Certain circumstances seem to point to his having kept all the way from »Sponjen Baptse-tso» to a more southerly route than I did, for not only does his map show a very broad valley, but on the right or northern side of it I find in a little side-glen the words »Kundo-Gomba (abandoned)». When I inquired of my Tibetan escort, whether they knew of any old monastery bearing that name, they unanimously agreed that there was one, and when, at Bondsching-tso, I

LOOKING N. 45° W. FROM CAMP CXIV.

asked them to point out in which direction it lay, they pointed due west, and declared that the old monastery lay to the left, that is to the south, of my route. But their statement, that it has not been inhabited during the time of the existing Grand Lama or during the lifetime of any of his four immediate predecessors, is of course not to be relied upon. If Littledale's own map is correct, and if the information which the Tibetans gave me about the position of the monastery is likewise true, then the conclusion we reach, and this is the main thing, is that from Bondsching-tso Littledale really did follow a more southerly latitudinal valley than that which I travelled up. Possibly his valley is to be identified with that from which Amlung receives a couple of tributaries, as I have already said. And in that case that latitudinal valley will presumably open out towards the west into the expansion in which lies the Kungdur-tso; a lake I did not touch at all. That I am right in this would appear to follow also from the circumstance, that from Bondsching-tso Littledale kept on due west, while I held to the west-north-west and north-west. The range which, according to my supposition, ought to separate Littledale's route from mine is called by the Tibetans Ovre. For the future we shall not come any further into contact with Littledale's route, for he kept to the south of me all the way to Ladak. When travelling along the southern shore of the Perutse-tso we were however at no great distance from him, because he saw that lake to the north, and has entered it on his map. He calls it the Peroktse-Tso, and at that point his itinerary, which passed about 4 miles south of the lake, ran for a short distance towards the west-south-west, whereas from the western shore of that lake I proceeded towards the west-north-west. I have therefore no further need to concern myself about the relations between Littledale's route and my own. The work which he accomplished, even though deficient in details, is in a high degree meritorious, especially when the inconceivable difficulties are remembered under which a European travels in those regions. During the course of my further journey towards the west and north-west I only once or twice came into contact with Nain Singh's route, although from my own route-plotting it is impossible to say where I crossed his line of march. The general map which is intended to accompany my atlas, and on which are entered the points that I determined astronomically, will, I hope, enable me to settle this point. Nain Singh's map is executed on an even smaller scale than Littledale's, and on it the orographical details and indications of the surface features are entirely sacrificed to the broad features of the general relief.

CHAPTER XIII.

THE OMAN-TSO, THE DADAP-TSO, AND THE PERUTSE-TSO.

The Tibetan escort which joined us here was more communicative and trustworthy than its predecessors, at all events the new men seemed to be less and less chary of speech in proportion as the distance from Lhasa increased. I take the opportunity to subjoin some of the information that they gave me. Between the Luma-ring-tso, a lake which we should reach in a few days' time, and another lake called Tschag-tsaga there exist seven similar *tsagas*, or »small saltwater pools», namely Jagtschin, Nagbo-schuksa, an unnamed pool, Marvo-dagsa, Nodba-lantsa, Op-tso, and finally one the name of which they did not know. The locality in which these pools are situated is very sparsely inhabited; generally there are no nomads there at all.

With regard to the climate, they said that in this locality and in the whole region to the west considerable quantities of snow would fall within about two months, that is in the end of December, and after that the route which we were then about to attempt would be quite impassable. At that season officials, when they have to travel between Lhasa and Rudok, as well as merchants with their yak caravans, choose the route *viâ* Tok-dschalung, that is they keep south of our route. But the quantity of snow is very variable. The year before (1900) it had been exceedingly copious, and consequently it was expected that that year (1901) the fall would be somewhat less in amount; which would seem to indicate that my informants were not wont to experience two snowy winters immediately following one another. In these regions the rainy season occurs at the same time as at Lhasa, although the precipitation in summer and autumn is very variable, and according to what my Tibetans declared, in any case smaller in amount than in the neighbourhood of Lhasa. Such statements must of course be accepted with caution. Such as they are, they amount however to this, that the precipitation, which falls in the shape of rain during the rainy season, appears to increase from west to east, whereas the opposite is the case with regard to the snow, which decreases from west to east.

At a little distance from Camp CXV there was a nomad encampment, as indeed was evident when a couple of nomad boys brought us both fresh and sour milk.

October 27th. A tolerably monotonous stage, though the country suited the caravan; the west wind was less violent than usual, and the surface hard and with a uniform fall. In the lowest part of the depression, still a long way off, we perceived a lake. The big open latitudinal valley is bordered on the north by a rounded range of moderate elevation, but barren and devoid of colour, as also without snow. In front of it stands a small black butte called Nagmo-tsuk. According to what our escort said, there were nomads in the eastern or south-eastern continuation of this latitudinal valley, and in proof of what they said they brought us sheep and milk. Thus there are occasionally nomads to the north of the route we were following, although one may be pretty certain, that their numbers are not great.

Fig. 108. TIBETAN BOYS.

The northern range of the latitudinal valley terminates north-west of the Dadap-tso, and beyond its terminal buttress we saw at a pretty good distance away a level, open country, which in its turn was bounded by a fresh low range. That points clearly to the end of another latitudinal valley of the broad, flat type, a valley running parallel with ours. We kept quite close to the foot of the southern range, having next to us on our left low hills seamed by dry gullies, but beyond them every now and again a snow-capped peak belonging to the main range. One of these peaks, J_3, is called Jang-tschag-tsa. We passed the outlets of a couple of bigger transverse glens or watercourses, one of them called the Rong-na. These never at any time carry water. It was astonishing how seldom we came across water in

these mountainous regions, for one would naturally expect to find it in abundance. For considerable distances these western valleys of the Tibetan highlands are very ill provided in this respect, and the mountains sometimes give the impression of being true desert mountains like the Kuruk-tagh. The supply of water varies however with the season. Just that period, the beginning of winter, is without doubt the driest part of the year. In the latter half of the winter snow at any rate falls. During the rainy season water will doubtless be found everywhere; sometimes there will then be hardly a single torrent dry. The fact of so many of the mountains, lakes, and transverse glens in this region bearing names is a proof that the nomads do sometimes visit it, and other witnesses to the same fact are the stone sheepfolds which we saw. In the summer therefore the pasture must be relatively good, or at all events better than in the country which we had last travelled through. The explanation lies in the fall in absolute altitude down towards the depression of Dadap-tso, and the somewhat sheltered position which the locality consequently enjoys.

Fig. 109. TIBETAN ENCAMPMENT.

On the right of our route, that is towards the north-east, the surface of the latitudinal valley slopes down towards its middle, though we failed to observe any main watercourse; but no doubt there is one, however faintly it may be indicated, and it will run north-westwards towards the Dadap-tso. The bottom of the latitudinal valley is in general hard, strewn with gravel, and but slightly undulating. After traversing the district of Na-ngamba, we passed an obo, constructed in a way with which we were not familiar: for it resembled a stone chest, 4 m. long, 1 m. broad, and $1\frac{1}{3}$ m. high; round its sides were propped engraved stones, and yak and sheep horns, and on the top of all was a little peg bearing a red flag or streamer. A little bit farther on we passed two similar obos as well as a sheepfold built of stone. As we learned subsequently, this is the usual form given to the

Lmstr. A. B. Lagrelius & Aeschehoug.

OUR YAKS DRINKING AND GRAZING ON THE SHORE OF THE BONTSCHING-TSO;
THE MOUNTAINS ON THE NORTHERN SIDE OF THE VALLEY, CAMP CXIV.

CAMP CXIV, MOUNTAINS ON THE SOUTHERN SIDE OF THE VALLEY.

obo or *mane* in Ladak, especially in the neighbourhood of Leh. This was in fact the most easterly obo I saw that betrayed traces of Ladak influence.

The obo in question crowns the summit of a terrace, 4 or 5 m. high, which can hardly be anything else except a former strand-rampart of the Dadap-tso; for this lake, like all its neighbours, is shrinking. What remains of the lake, and it is very little, and almost circular in shape, lay quite close to us on the north side of our route. Its shores, exceedingly flat, gleamed white with gypsum and saline incrustations. To the north-east of the lake we perceived the characteristic crescentic clay

Fig. 110. THE FIRST OBO OF LADAK TYPE.

expanses, yellow, level, and dry, which mark successive stages in the shrinkage of the lake; they are even yet at times covered with water. After doubling a north-going shoulder of the southern range, we came upon a level area of chalky white gypsum, which stretches between the Dadap-tso and the still smaller lake of Oman-tso to the south of it. This gypsum expanse differs from those which we have considered before in that its surface is practically level, without the mound-shaped and pyramidal gypsum elevations that are peculiar to the similar expanse around the Lakor-tso. As the intrinsically quite small isthmus between the two lakes can only be one or two meters above their level — and they may indeed be said to lie at the same *niveau* — it is evident, that the gypsum expanse there has only recently been exposed by the departure of the water from off it, so that wind and water have not yet been able to model its surface. Of erosion one can hardly speak in such a case, for the gypsum expanse is sheltered between the lakes, and lies in a part of the big latitudinal valley into which no river ever finds its way. But the direct erosive action of the precipitation, in conjunction with the effects of the wind, will some day make this gypsum expanse just as rough and irregular as those which

CAMP CXIV, MOUNTAINS ON THE SOUTHERN SIDE OF THE VALLEY.

we saw before and as those which we encountered afterwards. Grass grows, though excessively thinly, on the gypsum area.

The Oman-tso once constituted a south-westerly bay of the Dadap-tso, but is now completely cut off from it. Of the former connection there still remain traces

Fig. 111. TWO OBOS NEAR LEH, LADAK.

in the shape of one large lagoon and two small ones, all very shallow, on the isthmus. These are situated quite close to the northern shore of the lake, but have no connection with it; they are doomed to a speedy disappearance. The strip of land between them and the principal lake is very narrow and lies only a shade above

the level of the lake itself; but it was firm enough to bear, so that our Tibetans were able to make a short cut that way with their yaks. The water in these lagoons, as well as in the Oman-tso itself, was perfectly fresh, and all were then frozen, except for some open spaces which showed near the west side of the principal lake; probably there were springs there. On the southern shore of the Oman-tso there is a very distinct terrace, apparently at the same level as the terrace which we saw near the obo. It is very strange that there should be fresh water in this little lake at a time when it is shrinking; one would naturally expect to find it salt. It may be that it lies a shade higher than the Dadap-tso and communicates with it by an underground channel. The water of the latter lake is, my Tibetans de-

Fig. 112. SOME SMALL RUINS AT OMAN-TSO.

clared, salt, but all the same it can be drunk in case of necessity. The Oman-tso means the Milk Lake, the meaning being that its water is as sweet as milk. In the lower part of the narrow latitudinal valley that runs towards the west-south-west, there exist several springs just above the lake, and again during the rainy season its water is freshened by big floods from the southern mountains. Moreover, as the isthmus between the Oman-tso and the Dadap-tso is so extremely low, it only needs a very inconsiderable rise in the former to set up a broad, shallow current out of the first-named into the latter. True, we did not observe direct traces of any such temporary overflow, but on the soft gypsum surface they would very soon be blotted out. If however my supposition is correct, the Oman-tso does not fill a self-contained basin, but discharges into at any rate the Dadap-tso. This would explain the lake's immunity from saltness.

From the northern shore of the big pool we inclined towards the south-west, and continued for a space along the north-western shore of the Oman-tso, having

immediately on our right the red rocky buttresses of a bluff, the external features of which are however rounded in character. The mountain-range on the opposite or south-east side of the lake is high and imposing. Camp CXVI was formed on the lake-shore, its altitude being 4509 m. Some nomads were resting not very far away.

I took my first geological specimen that day not far from the preceding camp; it was a hard, red porphyritic variety, dipping 33° towards the S. 60° E. The same rock occurred in several different varieties in the reddish bluff above Camp CXVI, its dip there being extraordinarily distinct at 16° towards the N. 30° E. By reason of this position it shows long, red, sharply defined edges jutting out of the detritus on the southern flank of the mountains.

The 28th October was a fairly interesting day, though the wind blew hard from the west with a serene sky; there was more variety than on the preceding days. Not far west of Camp CXVI we passed a very low rectangular stone wall, a few meters long and divided by an internal wall into two parts. Our Tibetans could not or would not tell me what it was for; but probably it marks the site of what was once a little temple, for not very far from it there exists an obo of precisely the same kind as that which we passed the day before. As a rule, and especially in Ladak, these *mane* kists are almost always built in the vicinity of a temple. But the temple or monastery beside the Oman-tso appears to have been deserted long ago; or it may be that its constructors never advanced farther with it than the foundations. There are no stones scattered about the vicinity to betray the possible collapse of a wall.

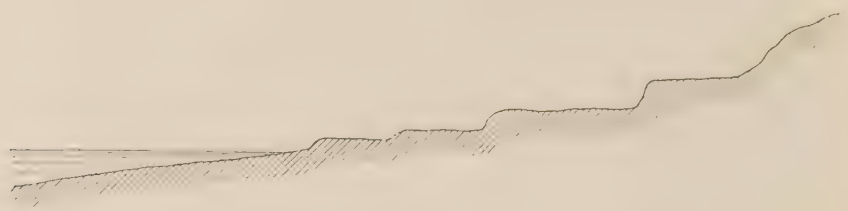


Fig. 113.

Our latitudinal valley, which at the Oman-tso joins the big open depression of the Dadap-tso, led us to the west-south-west. The Oman-tso soon comes to an end in a long tapering bay, then covered with ice. The lake is continued towards the west-south-west by a narrow hollow, which we kept immediately on our left. It was full of marshes and pools and contained several freshwater springs. In the range on the southern side of the valley one sharp-pointed snow-capped peak close at hand was an especially conspicuous object: it sends out spurs towards the north, between which steep transverse glens open out. Above that peak comes the outlet of a particularly big transverse glen, the stream of which originates a long way east of the round-topped peak, and upon emerging into the latitudinal valley it gives rise to a flat fan-shaped gravelly scree, which encroaches upon the valley to such an extent that at the foot of the northern range there is only room for a narrow strip of level ground.

On the northern shore of the Oman-tso old strand-terraces are again distinctly visible. In number they are four, and lie quite close to one another (fig. 113). The upper-most is the biggest, as at the Lakor-tso, but its relative altitude above the lake is only about 25 m. All four terraces can be distinctly traced to the western end of the lake; there the three lowest ones come to an end, while the uppermost one continuous a little bit farther, and then it too ceases. On the flat strip of yellow clay, extremely low and narrow, that occupies the space between the recently mentioned gravelly scree and the foot of the northern range, there is again a distinctly defined terrace, which is no doubt identical with the uppermost of the four terraces that I have just spoken of. But the beach-line ceases before even the strip of clay

Fig. 114. MOUNTAIN ON THE SOUTHERN SIDE OF OMAN-TSO.

thins away in the west. Here a temporary lake is formed when water comes down the big transverse glen. The differences of altitude in the latitudinal valley are very slight and the results given by the aneroids cannot in such cases be relied upon. There can however be no doubt, it seems to me, that the strip of clay lies higher than the marsh and the pools, that these lie a shade higher than the Oman-tso, and that the Dadap-tso is consequently the last reservoir of the drainage of the locality. At the time when the uppermost terrace, nay even when the lower terraces formed the shore-line, all these different basins were, as I have already said, connected together and formed a salt lake. But after the Oman-tso was cut off, its water turned fresh, a fact which points to its having a subterranean emissary. Even then, winter though it was, the lake was receiving, I suppose, a certain amount of water from the marshes and pools which lie immediately west of it, where the springs issue. With regard to the temporary lake, then indicated by a flat expanse of clay only, it hardly seems to possess any outflow into the Oman-tso, for I failed to detect in that part of the latitudinal valley any traces of an eroded

watercourse. The main body of the water that comes down the big transverse glen — and during the rainy season it must represent a considerable quantity — keeps close to the foot of the round-topped peak, flowing in an energetically excavated bed; this orientation again points to a fall towards the Oman-tso.

Approximately south of this locality is reported to be the district of Odok or Ovok, with the pass of Ovok-la. The mountain-range to the north is designated quite simply by the name Ning.

The valley curves like a scimitar in that it trends towards the west-north-west, increasing at the same time in breadth. Its floor undulates slightly; but generally it is quite impossible to tell in which direction the surface slopes. In fact the valley appears to be divided into a chain of quite small and quite shallow self-contained basins. Farther on there occurs quite a chain of freshwater springs, bubbling out along the foot of the southern range, and these give origin to a number of pools and marshes, their shape, long and narrow, being prescribed by the relief of the bottom of the valley. Through a broad glen-opening on the right we caught sight, to the north-east, of a light red, fairly imposing mountain-mass called Dagre. Farther on, overhanging the valley itself, comes a black bluff, known as Nagbo-tse. To the north rises a smaller bluff called Adong and a mountain to the left, or south, is known as Langbo-dong. We did not see a single tent, though in one or two places we did see the usual semicircular stonewalls that are used as sheepfolds; their interior was always black with sheep-droppings. As this substance makes first-rate fuel, we always halted and filled a couple of sacks with it to carry with us.

The first three pools were filled with perfectly fresh spring-water, and the first two were quite frozen over, though the third was only half frozen. From it trickled a little rivulet, which ran west-north-west and emptied itself into a considerably bigger pool, encircled by a belt of white ground, proving that its water was salt. This pool lies quite close to the base of the southern mountains, its western side being in intimate contact with a sharply defined terrace only a few meters above it and forming a threshold athwart the latitudinal valley. On the top of it was a sheepfold.

Ascending almost imperceptibly, we next reached the crest of this little swelling, when to the west there burst upon our sight a view that was as magnificent as it was unexpected, an entirely fresh panorama in fact, and very unlike the regions which we were leaving behind us. On the right the bluff of Nagbo-tse came to an end in a headland bearing N. 53° W. In the N. 59° W. we perceived the northern end, or rather a portion of the north-eastern shore, of a fresh salt lake, occupying a great part of the middle of the vast basin that stretched away west at our feet. This is the Perutse-tso. As usual, I remained a good long while on the summit of the pass in order to take my bearings. Round the shores of the lake there were actually bushes: even at that distance we had pleasant premonitions of both grazing and fuel. This was one of those resting-places and rallying-points in the course of a journey through high Tibet which afford your entire caravan an opportunity to recover from the fatigues it has undergone, and to strengthen itself for the journeyings that still lie ahead of it.

The Perutse-tso is on the whole circular in shape, and thus belongs to the same round shallow lacustrine type as the Selling-tso and the Dadap-tso; indeed scarce any of the encircling mountains appeared to approach anywhere close to its shores. That the lake is very shallow was quite evident from the belt of flat mud which projected just a shade above the water in the middle; possibly it is only just at that season of the year that it becomes exposed.

We rode down from the threshold-pass towards the south-west, leaving behind us a rugged, rocky shoulder of the southern range. The slope, which is in some places crossed by big watercourses, has a very gentle fall, and is overgrown with balghun bushes reaching 1 1/2 m. in height and possessing magnificent dry roots, thicker than a man's arm. Just as the tamarisks do in the basin of the Tarim, so here with these bushes: each grows on the top of a mound 1 m. high. This was the first point on the way to Ladak where we found bushes; balghun bushes we had not seen since we left Temirlik, but we had by this descended so far, to about 4500 m., that those bushes were able to thrive again. It turned out however that in this regard the Perutse-tso neighbourhood is only a pleasant oasis; for until we drew near to the region of the Panggong-tso bush vegetation still continued to be a rarity, but at the latter lake nature changes in more than one respect.

We continued towards the south-west until we reached the shore, which we then followed closely for some distance. The surface was very hard, consisting of coarse, consolidated sand, furrowed by watercourses and dry torrents, issuing out of the mountains to the south. These, for as far as they were visible to us, are of moderate elevation and send out spurs down to the shore of the lake. It was somewhere amongst these low mountains that Littledale travelled. As a rule each watercourse pursues its own independent path to the lake, that is to say, it does not unite with any of its neighbours before entering it, and they are also, as a rule, about one meter deep. Alongside the lake where we then were, that is on our left, we had a couple of old strand-terraces, low, but defined with especial sharpness. But the phenomenon was only noticeable where the hills advanced quite close to the southern shore of the lake; otherwise that shore is so flat and level, and has such a gentle slope, that terraces could not be formed. The flat ground between the water's edge and the lowest terrace was still moist, and had it not been frozen, it would assuredly not have borne. Here were numbers of tiny rivulets, all of them entering the lake. Close along that shore the water was therefore perfectly fresh; though farther out it would of course be salt, unless its position and habitus spoke altogether falsely. So far as we could see from our route, the lake was entirely lacking in both animal and vegetable life. In colour its waters were a light dirty green; but the belt of sediment in the middle, which I have already mentioned, glinted white, being like a big island, and its south-eastern corner approached quite close to the shore on which we were travelling. Seen from a distance, this flat patch of sediment looked like an ice-field. In places luxuriant grass was growing on the shore on our side.

On the left we passed a rocky promontory, while on the right the marshy, swelling shore-line of the lake trended away to the north. Our strip of shore consequently continued to broaden out, being bordered on the south by a single ter-

race only, which however was very conspicuous in the flat country, for it is 4 to 5 m. high and slopes down steeply towards the depression. Here was a little rivulet issuing from a spring and still flowing, which had carved out for itself a deep and sheltered bed. Next we passed a projecting elbow of the terrace and then crossed over a dry watercourse. After that we came out upon the open country south-west of the lake. Here, upon looking around us, we perceived three terraces, all very distinct, though the highest was not, I suppose, more than 20 to 30 m. above the level of the lake. The lowest, which we followed, sometimes close at hand and sometimes at a greater distance, defines a former beach-line of the Perutse-tso, and it is not so very long since it was abandoned, as is abundantly proved by the properties of the ground. Where dry, this was rough, lumpy, and cracked, of the same type as the similar dry expanses that occur, for example, west of Temirlik, or in the vast region of Tsajdam or around the Kara-koschun. It is in fact typical *schor*, the bottom of a salt lake recently laid bare. Such surfaces are however relatively rare below the lowest of the terraces which I have mentioned, for the greater part of the country there is occupied with extensive marshes, with grass growing amongst them, and several open pools, all at that time frozen over. In numerous places there were also springs; and the water in the locality was generally fresh. It would require but a slight rise in the level of the lake to put this marsh under water, and possibly this does sometimes happen. Except the relatively low terraces which I have mentioned, we saw no others in the region round this lake. However, they are sufficient to justify us in subsuming the Perutse-tso under the general rule, that all the salt lakes in central and western Tibet, indeed we may safely say all the salt lakes throughout the Tibetan highlands, are undergoing a process of desiccation.

On the northern and north-western shore of the lake rise three mountain bluffs, though at the great distance at which we were from them it was impossible to determine whether they stood close to the lake or were separated from it by a broader stretch of flat, level ground. These mountains, which are practically isolated, are of insignificant size. To the west we perceived several ranges of higher mountains, though to the north-west the country was open right away to a very far-off range. This was the latitudinal valley in which we were to march during the next few days, and of which the Perutse-tso forms a special part.

Our Camp CXVII, beside the Perutse-tso, stood at an elevation of 4497 m., only a couple of meters above the lake. Here the grass was thick and soft, although withered; for that part of Tibet it might however be pronounced excellent. West of our camp was a long belt of balghun bushes, which not very long ago stood on the actual lake-shore. These furnished us with a plentiful fuel. As there was likewise an abundance of spring-water, this locality may with reason be pronounced one of the very best that we had seen since we left Tscharklik. There were marshes also to the south-west of the camp. On our arrival we found 25 Tibetan horsemen, with some forty yaks, waiting to escort us on our way. It was from them that we learned the true name of the lake, Perutse-tso; for our old escort had called it Jim-tso. From this place the distance to Tok-dschalung, to which there was said to be a road farther south, was approximately the same as to the lake of Tschag-tsaga, or about six days' march.

Ljustr. A. B. Lagrelius & Westphal.

THE PERUTSE-TSO.

The rocks we saw this day were as follows: at the salt pool immediately east of the little pass a dark greenish schist, dipping 51° to the N. 85° E. and seamed with a vein of fresh and beautiful grey granite, at the sides of which the schist was especially hard and assumed an angle of 40° towards the N. 72° E. The same crystalline schist, together with the granite, cropped out also in a small steep side-glen, that comes down from the southern mountains to the lake. The lower part of this little side-glen cuts through certain soft white strata, lying 18° to the N. 30° W. A specimen which has been examined by Mr. Aminoff turns out to consist for the most part of calcium carbonate with a smaller percentage of gypsum. On the left side of the threshold pass is a rather coarse granite, bedded at 48° to the S. 12° W.; in it occurred veins of a hard, finely crystalline schist, of a dark-green colour. The flanks of the red mountains are everywhere strewn with fragments of this rock. The same rock occurs again in a little knoll that crops out on the very shore of the Perutse-tso, dipping 74° to the N. 17° E. Fragments as well as blocks of this stone are likewise common in places on the southern shore of the lake.

Fig. 115. LOOKING N 50 E FROM CAMP CXVII; MT NAGBO.

During the four days that we spent beside the Perutse-tso the wind blew incessantly from the west, sometimes with hurricane force, driving before it in thick clouds along the ground everything of the nature of loose dust or fragments of dry plants. It was impossible to screen yourself against it: even the bell-shaped yurt which I occupied was not enough; for even when you have your tent-opening to the leeward, there is always an eddy of dust and sand dancing and whirling up like smoke in front of it.

At this lake wild-geese were numerous, though they were all birds of passage. Indeed they did not even rest on the shores of the Perutse-tso, but kept flying over it, with loud screamings, though only at night. They were evidently on their way from the lowlands of inner Asia to India. As it was a long time since we had seen wild-geese, and as after this we very seldom saw them either, this depression would seem to form one of the great highways which they have no doubt followed in their migrations from time immemorial. It is of course quite reasonable that they should endeavour to fly across the flat parts of the plateau, and, consistently with keeping to as straight a line as possible, should avail themselves of the biggest depressions, for over them the air is relatively less attenuated, and in that way the geese avoid crossing over the tops of the high ranges. They have of course many similar routes; indeed we observed several of their stopping-stations in the lacustrine regions of eastern Tibet and others at the Basch-kum-köl. How interesting and instructive it would be to have a general map of the whole of Tibet with all the isohypsometrical curves entered on it, and also with the migration tracks of the wild-geese! But the construction of such a map is at present impossible, and indeed it will long

be impossible; for it cannot be done even after the whole of the country has been mapped. Yet it is at all events allowable to believe, that their migration tracks bear some sort of fixed relation to the relief of the highlands: that is to say, that the lines which would, on the map imagined, indicate the paths taken by the wild-geese in their periodical migrations would also coincide with those parts of the country in which the isohypsometrical curves would show that the lowest elevations run.

I have briefly alluded to the strand-terraces which we saw beside the southern shore of the Perutse-tso, and which in point of age correspond to the lower beach-lines around the Lakor-tso. They show more distinctly than anywhere else beside the little dry watercourse or glen that winds down to the lake from the south-south-east. From our route we saw only three terraces. On the 30th October, starting from near the outlet of the glen at the lake-side, I took levellings along the east bank of the watercourse, that is towards the south-south-east, with the object of ascertaining exactly the altitudes of the terraces above the lake, and their respective distances from the water's edge. The levelling-mirror was supported, as before, 1.50 m. above the ground. The first terrace, which is quite low and insignificant — in fact it was not visible at all from our route — is situated at a distance of 297 m. from the lake. It can hardly be called a terrace, but is rather a rampart, frequently broken, which appears to be finally lost amongst the littoral marshes to the west. The second old beach-line or strand-terrace is likewise low, but distinct. It is situated 1046 m. from the lake, and appeared to be continued towards the S. 73° W. It is between these two terraces, which thus lie a considerable distance apart, that the eroded watercourse becomes lost in the schor, growing shallower and less distinct, and finally giving out altogether; and there is nothing to indicate that its temporary torrents ever succeed in getting down as far as the lake. Probably, when the stream is bigger than usual, a temporary marsh or shallow marginal lake will be formed between the two lowest terraces. It is indeed possible that there will then exist an outflow from this marsh into the lake through one of the gaps in the lowest rampart. The third terrace is situated at a distance of 1076 m. from the shore; thus the distance between it and the second terrace is only 30 m. It appeared to continue at first towards the S. 70° W. and afterwards, like the second terrace, to incline more and more towards the north-west; but very soon it disappears altogether. We found the fourth terrace at 1279 m. from the shore, and it continued towards the S. 80° W. And lastly there was a fifth, 1350 m. from the shore, which proceeded due west. All the four upper terraces are pierced by rainwater channels, and these grow increasingly deeper in proportion to their distance from the lake. Above the terrace which I have here called the fifth, but which, strictly speaking, ought of course to be designated the first, we saw no further signs of the Perutse-tso having reached a higher level. The lowest terrace, no. 1, lies 4.50 m. above the existing lake; no. 2 lies 24 m. above it; no. 3, 25.50 m.; no. 4, 31.50 m.; and no. 5, 39 m. Thus the rise along our measured line was 39 m. in 1350 m., and consequently not altogether inconsiderable, seeing that the outermost, flat spurs of the southern range are still in evidence there. But quite different are the relations at the point where Camp CXVII stood. That was pitched, as I have said, at the edge of the extensive marsh, and immediately above it ran the lowest of the five ter-

races. In other words, the slope down from the foot of the western mountains is much more gentle than the slope along the line which we levelled. Accordingly the contour-lines have been more easily modelled in the latter quarter, while they stretch a good long way westwards in order to keep to the foot of the mountains. And with this the position which the lake occupies with regard to the adjacent country is in full agreement; that is to say, when the lake was 39 m. higher than it is now, it was elongated in the same direction as its latitudinal valley runs, namely from east-south-east to west-north-west. There is presumably nothing to prevent one Tibetan lake from drying up more quickly than another. If the desiccation is occasioned, as in the present instance, by a diminishing precipitation, then the several lakes ought on the whole to dry up at approximately the same rate, and their subsidence ought to proceed at pretty much the same rate in them all. But there is yet another factor that has to be taken into account, namely the different positions which the lakes occupy with regard to their environment and in relation to the water-bearing strata. A very extensive and shallow salt-lake will of course dry up faster

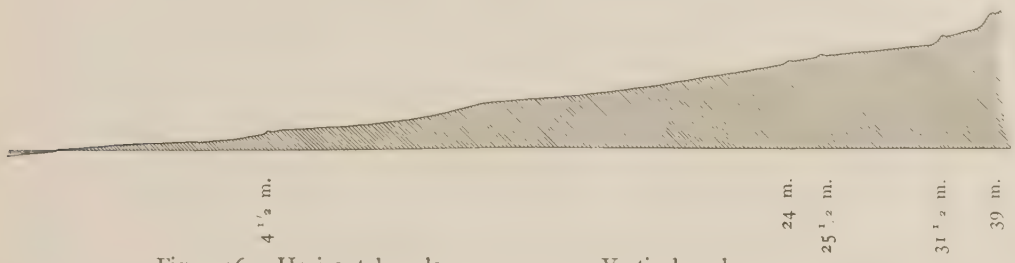


Fig. 116. Horizontal scale = 1 : 10,000. Vertical scale = 1 : 2,000.

than a small and relatively deep lake; and in the case of the former the desiccation may proceed so fast that terraces have hardly been able to come into existence on its flat shelving shores. Accordingly, in the case of the Lakor-tso, it is the highest terraces that are the most distinctly developed, and they originated at a time when the neighbouring mountains plunged straight down into the lake. The smaller the lake grew the nearer did it approach in shape to the saucer type, and the more indistinct did its terraces become. Beside the Perutse-tso the terraces are only visible where the slope of the shores is more pronounced, to speak solely of those parts of them that I visited. If, as we have seen, the Lakor-tso once lay 133 m. higher than it does now, we may certainly assume that the fifth terrace beside the Perutse-tso, which only reaches 39 m. above the existing level of the lake, in no sense corresponds to the altitude of 133 m. which was simultaneously reached by the Lakor-tso; but at that time the Perutse-tso also rose far above the level of its present fifth terrace. A more detailed and more extensive examination all round the lake would undoubtedly reveal the existence of several older terraces, even though they be in a fragmentary condition. That we were unable to detect any above the fifth terrace may have been purely an accident, and due more particularly to the erosion of the wind acting in the very open valley. At the present time the lake has reached such a languishing condition that its remaining days are not many; the exposure of the bottom of the lake in the middle is a proof of this.

CHAPTER XIV.

THE TSOLLA-RING-TSO AND THE LUMA-RING-TSO.

On the 2nd November we continued towards the north-west, up the broad latitudinal valley and nearer to the bordering mountains on the south. The protuberance which I had designated O3 turned out to be the fork or foreshortening of a range, which however came to an end, after we had had it for a few kilometers on our right hand. It is almost separate from the neighbouring mountains and does not border the latitudinal valley anywhere on the north. After we had passed it, there appeared in its place other mountains, tolerably low. M3 and N3, which had also appeared at first to be detached peaks, turned out to be similar bifurcations of ranges that run parallel to our valley and form part of its northern boundary.

Leaving on our left the little belt of bushes, we crossed over a small spring-fed rivulet, which was flowing towards the north, where it entered a running stream, the name of which was, I was told, Ombo-tsangpo. This issues out of the mountains to the south-west and proceeds N. 65° E. to the Perutse-tso. It is said to be fed exclusively from springs, which are numerous in the mountains to the south-west. So far as we could see it was at that time everywhere frozen, this being a consequence of the exceedingly gentle fall; and to the same cause must be attributed the extraordinary way in which the river winds. But the ice was not yet sufficiently strong: for while it bore men on foot well enough, and even horses in places, the yaks went through, and so we made them open a passage through the ice for the camels. Both the depth and the volume were then small.

The mountain in the west-south-west was called Ombo-jutse, but beyond it appeared a higher crest, with some snow on it, called Nagbo-tsesum. One or two dry watercourses made their way towards the lake. We passed a second belt of balghun bushes on our left hand, growing at the foot of a distinctly defined terrace at the base of the mountains. As the slope there is extraordinarily gentle, this terrace can hardly lie higher than the highest of those which we measured last; perhaps it corresponds to the third or the fourth of them.

Not far west of a locality called Nagnar, at the foot of the southern mountains, is the outlet of a transverse glen of considerable size, coming from the south-south-west and called Pamo-ka. Through it a track is said to lead to a district known as

Paktschuk, probably only summer grazing-grounds with springs. The nearest mountains on the right, where the little isolated range terminates, is called Jugmo. Farther on the southern range is known as Jungla-tak. Matscha and Naktscha are the names of two conspicuous rounded protuberances on the north of our route. A locality to the

Fig. 116. CROSSING THE OMBO-TSANGPO.

south-west is known under the name of Hare-sädschir, and a smaller snowy summit in the south-east as Janak, this being apparently a part of the crest called Nagbo-tsesum. It is also conceivable that different tribes give different names to the same locality; the Perutse-tso being a dialectal boundary-line of this description between

Fig. 118. CROSSING THE OMBO-TSANGPO.

two regions the inhabitants of which possibly possess separate names for one and the same geographical object. For instance, the Tibetans who accompanied us from the east called that lake Jim-tso or Jigen-soptse, whereas those who met us there from the west called it Perutse-tso. It is only the circumstance that the latter form is given by Littledale, though spelled Peroktse-tso, that has induced me to stick to this name in preference to the other.

Camp CXVIII was pitched in the vicinity of two sheets of water, little pools, forming the surviving relics of a lake. The place is called Harschu. Adjacent parts of the northern range are known as Tsemar and Jarak.

During the course of the day we passed a very flat, scarcely noticeable threshold, forming a water-divide, which possesses a certain amount of hydrographical and morphological interest. According to my hypsometrical instruments, our camp at Harschu lay at an altitude of 4454 m., and our camp beside the Perutse-tso at 4497 m., while the dividing threshold reached 4503 m. During the course of the next day's march from Harschu we went down something over a score more meters, that is to the edge of the next depression, occupied by the lake of Tsolla-ring-tso. This lake has, as we shall see, reached an even more advanced stage of desiccation than the Perutse-tso. It almost looks however as if both depressions had once been connected together, and so formed a single long lake, and indeed they are situated in one and the same latitudinal valley. If the three altitudes which I have just quoted are anything like trustworthy, the differences of elevation are here very slight. The altitude of the Perutse-tso is in particular relatively sound, because the observations taken there were spread over a space of four days. The altitude of both lakes was determined with a boiling-point thermometer and three aneroids, but the altitude of the pass by the aneroids only. The threshold-pass lies then only 6 m. above Camp CXVII, which itself stood at the most only 4 m. above the Perutse-tso, so that the difference between the threshold and the lake is only 10 m. Now the strand-terraces beside the same lake reach up to 39 m. above its present level; whence it follows that it was only the lowest of them, No. 1, which belonged exclusively to the basin of the Perutse-tso; the other four must have belonged to the higher terraces of the Tsolla-ring-tso, and consequently must have run along the foot not only of the mountains on the south but also of those on the north. One of these continuing terraces we did indeed observe just above the second belt of balghun bushes. A rise of only 10 m. in the level of the Perutse-tso would suffice to cause its water to flow across the threshold; but to produce the same effect, it would require a rise of 49 m. in the depression itself and in the lake of Harschu, and of 69 m. in the Tsolla-ring-tso: that is to say, when the two lakes, the Perutse-tso and the Tsolla-ring-tso, were united, the basin of the latter would be 69 m. deeper than the basin of the former. In other words, its subsidence and desiccation have proceeded at a much faster rate, seeing that the level at Harschu is now 49 m. lower than the pass. Nor is there anything surprising in the level of the western and deepest part of the former long lake having dropped at a much quicker rate than the eastern part; the difference admits of easy explanation. At the present time the basin of the Tsolla-ring-tso is not entered by a single affluent, if we disregard a couple of tiny rivulets that issue from springs. But the Perutse-tso, on the contrary, is not only entered by a great number of spring-fed rivulets, but it also receives a river, the Ombo-tsangpo, which even contributes water in the winter. Nor are these relations certainly altered during the warm season of the year, and

Fig. 119. LOOKING SOUTH FROM CAMP CXVIII.

especially during the rainy season; hence we may say, that the Perutse-tso under all circumstances receives a far more abundant inflow than the Tsolla-ring-tso. Even though the Perutse-tso is, as its terraces betray, dropping and nearing extinction, it is doing so at a slower rate than its neighbour lake, because its more abundant inflow makes the balance between + and —, or between influx and evaporation, less than in the case of the Tsolla-ring-tso. The Perutse-tso is therefore more tenacious of life, and will certainly outlive its western neighbour, notwithstanding that the latter was once 69 m. the deeper. I do not of course assert that the figures which I have given above are absolutely unassailable: the essential thing is that they are relatively pretty nearly correct. Whether the respective values turn out to be greater or less is of no real importance, for the reasoning which I have adduced above would still hold good.

We have thus found that in the space of time which the Perutse-tso required in order to drop 10 m., the Tsolla-ring-tso (to confine ourselves to the lowest part of the depression) has dropped no less than 69 m., counting from the moment when the two basins were finally separated at the point where the flat threshold-pass is now situated. The subsidence in the basin of the Tsolla-ring-tso has thus proceeded seven times faster than that of the Perutse-tso. At the beginning of this period of subsidence the Perutse-tso was of no very great size, although it was of course several times bigger than it is now, for it extended westwards close up to the threshold-pass. The terraces, counting from the 2nd to the 5th on its southern shore, date however from a very much older period, namely that in which the two basins of the depression were connected together. At the beginning of the same period of subsidence the Tsolla-ring-tso was a very large lake; not indeed much broader than it is now, but it stretched, as we shall see presently, a very long way towards the west. Its depth was also greater than that of any of the lakes which I sounded in Tibet; for at the moment when the threshold first emerged above the water the depth of this lake was equal to 69 m. + the maximum depth of the existing Tsolla-ring-tso, though this is indeed inconsiderable. Yet, however swiftly this western lake may have dropped, it nevertheless had sufficient time, and possessed sufficient power, to sculpture strand-terraces, as we saw, with the utmost distinctness at a distance of about 4 km. north-west of the threshold-pass. There were four of them, all running concentrically and quite close together, while there was also a fifth less distinct. But in the four km. that intervene between them and the pass we perceived no beach-lines, the reason probably being that the slope just there is almost imperceptible. Upon following the four terraces round towards the south-west, west, and west-north-west with our eyes, we discovered one or two of them indicated again, though faintly, at the foot of the mountains on the south side of the valley. But we failed to detect them at the foot of the northern mountains, though this may have been due solely to the greater distance and the less favourable light. These terraces, both those that our route directly crossed and those that run along the foot of the southern mountains, are of course formed in purely disintegrated material, though it is now hard and consolidated. There were no beach-lines visible in the hard rock.

One thing at once arrested attention, namely that these terraces exist solely and alone on the north-west slope of the pass, whereas on its eastern side they are entirely absent. In this circumstance I see a fresh proof of the correctness of the theory which I have already advanced, that the arrangement of these Tibetan lacustrine terraces proves generally, that even at the time when the climate was moister than it is now, and when the lakes were therefore bigger, the prevailing wind blew, as it blows to-day, from the west. The slope on the west side of the pass has in especial been in a high degree exposed to wind and waves beating upon it from the west, or rather from the west-north-west and north-west, for the shape of the valley forces the wind to make a local deviation. It was in that same direction that the old Tsolla-ring-tso stretched, and the waves which beat upon the eastern shore of the lake, along the lines of the four or five terraces, came from a long way off, namely from its distant western side, and consequently had plenty of time in which to grow to a considerable height. Thus, even though the period during which the lake maintained itself at the one level or the other may have been fairly short, the powerful and energetic action of the waves was nevertheless sufficient to accomplish a work which under other conditions would have required a much longer period.

On the eastern slope that stretches down from the threshold pass to the Perutse-tso no strand-terraces have been able to develop, and that for three reasons. The first and most important is, that this slope was sheltered from the everlasting westerly wind, the effects of which upon the western shore of the lake were practically neutralized. In the next place this slope is much flatter than the western slope, which reaches down to a deeper depression. Finally, at the period in question the Perutse-tso was considerably smaller than the Tsolla-ring-tso. The circumstance that the Perutse-tso remained for a relatively longer period at each of its respective levels ought to have operated in the opposite direction; but beach-lines are nevertheless entirely absent on the eastern slope of the threshold. A thorough examination of the whole depression would without doubt reveal the fact, that the best developed strand-terraces are to be sought for at the east end, upon which the waves, gathering way in their passage across the entire lake, beat with great force.

While the eastern slope down from the threshold is practically quite free from eroded watercourses, and in any case possesses no main drainage-channel, there does exist one in the north-western part of the latitudinal valley. It does not however come down off the pass, but is formed gradually out of the transverse glens of the southern range, the brooks of which unite one after the other to form a main watercourse. This stream flows close along the foot of the southern mountains, and finally expands as it approaches Lake Harschu, but disappears before it quite reaches it. From the northern mountains this main stream does not receive a single contributory. Thus the temporary torrents which arise in the northern glens never reach down as far as the principal glen.

In travelling through a latitudinal valley like this, — absolutely dry except for the two lakes and the Ombo-tsangpo — I was astonished to find no accumulations of sand anywhere; we did not detect so much as a rudimentary tendency to the formation of dunes. And yet one would suppose that the conditions favourable to

their origination were in a high degree existent: the ground is dry and level, inexhaustible supplies of detritus are furnished by the surrounding mountains, and as for the wind, the driving and dune-forming agent, surely it leaves nothing to be desired. The reason why there are no sand-formations, notwithstanding that all the conditions are favourable, can scarcely be anything else but this, that the wind blows too hard and is too violent to admit of the origination of dunes. On the surface of the ground there is not even the very thinnest sprinkling of sand and it is useless to look for loose dust: the ground is everywhere hard and consolidated. It consists of extremely finely divided powdery material, but it is pressed together into a solid mass, from which even the hardest wind is unable to remove directly so much as the smallest particle. Yet over this surface, as hard as asphalt, there occur considerable areas of coarse sand, too coarse to be used by the wind as material for dune-building, as well as finer gravel, but scattered so thinly that the underlying yellow soil shows through almost everywhere, after the manner shown

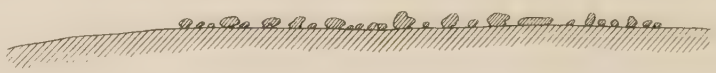


Fig. 120.

in the annexed illustration (fig. 120). All the finer matter, which was once intermingled with these coarser materials, has been blown away, so that the surface is swept perfectly clean of all movable particles, with the exception of such as are too coarse to be transported; and the consequence is that the latter remains behind, like a dissected and divided skeleton. This day we had a striking illustration of the process that goes on. There was virtually a gale blowing from the west. The horses' hoofs always loosen a small quantity of the hard surface; but this day no sooner did the animals lift their feet than the loosened soil was instantaneously blown away. Thus a veil of light dust hung in the wake of the caravan. No sooner was the soil converted into dust than it fell a prey to the wind. When I saw this I readily understood that dunes are *unable* to originate in this latitudinal valley; they *never get an opportunity* to form. And even though during a moderate wind a tendency should at any point be manifested towards the formation of dunes, the attempt would be rendered nugatory by the next violent storm, the material being blown away eastwards, until it comes to rest God knows where. The inconceivably violent wind that was then blowing, without a moment's cessation, so violent indeed that we could feel our horses staggering under us and struggling as if advancing in water, was also perfectly clear; there was not the slightest trace of drift-dust to be detected anywhere in that region. The storm of the day before had completely swept away all loose material which may chance to have cumbered the surface of the ground, and in the course of twenty-four hours no further quantity had been able to accumulate, or if it had it was already blown away. Thus during the season, when this »trade wind» blows so unceasingly, we are forced to the conclusion, that every the finest particle which the agencies of disintegration chisel out of the hard rock is blown away almost at the very moment of its birth, or rather rebirth. The relations here are both like and unlike those that prevail in the Desert of Lop. In

the latter we also had a hard clay desert, swept perfectly clean, without dune-formations; but on the other hand we found that the storms were always heavily charged with disintegrated dust and drift-sand, which is transported towards the west-south-west to be deposited in the Desert of Tschertschen. In both regions the wind blows too hard to allow of the origination of dunes.

The storm stopped at 7 p.m., but only for 1 1/2 hours, after which it began again, although less steadily, and it continued to blow all night. But the atmosphere remained so clear that stars of the fifth magnitude, low down close to the horizon, burned like distant fires; while those of the first magnitude in the zenith sparkled like electric lights, so that under such conditions the night in Tibet is never perfectly dark. At Harschu we again heard the wild geese screaming at night; during the day we never saw them. It is possible that they only travel by night in order to escape the violent wind, for as a rule the nights were almost always tranquil.

Our new chieftain told me, that in his province it was usual to count six months of winter, and during that time the west wind blows practically without a break. About 40 days after that, that is in the middle of December, snow was to be expected, but it might come a little earlier than that, and he advised us therefore to try and reach Ladak in twenty-five days, for in that case we should entirely escape it. As it turned out, we reached very nearly the end of December without any snow; but I quote these statements of the natives, all the more because they are mutually in agreement.

To Tok-dschalung, a place which later on we left to the south, the distance from our present camp was said to be five days. At these gold mines, which are said to be the highest place on the earth that is permanently inhabited, there remain during the winter only about a score of people. In the summer the population increases to between 200 and 300, who dwell in 60 to 70 black tents set up in a circle all round the gold-field, with its shallow mines or rather pits, out of which the precious metal is extracted in a very primitive fashion. There are neither temples nor stone huts at the place. The gold-miners come from several different directions, some of them even from Lhasa. The grazing round Tok-dschalung is wretched in the extreme, and after bringing up their belongings the miners drive their yaks down again to regions where the pasture is better, and there too they leave their sheep in the custody of shepherds.

Both Nain Singh and Littledale travelled, as I did, to the north of Tok-dschalung, Littledale's route running the nearest to it. The lake which Nain Singh calls Nimcho-chaka is possibly identical with my Perutse-tso, in that case Nim-cho would equate with Jim-tso. East of the Luma-ring-tso he places a small lake, to which he gives no name. This may possibly be the Harschu, a name that is also applied to the adjacent country. The Luma-ring-tso, which, properly speaking, is only a part of the depression that I have called after the lake of Tsolla-ring-tso, measures according to Nain Singh's map, 33 English miles in length; though it is difficult to see how he could map it accurately, seeing that he travelled at a considerable distance to the north of it and can evidently only have seen the lake at a single point, namely in the extreme east. Between his route and the lake there intervenes a big mountain-range. I suppose his information was obtained as the result of questioning the

natives. The Luma-ring-tso itself is a very small basin, only a few kilometers long; but if we add to it, as Nain Singh has done, all the salt-basins lying to the west of it, we get a very elongated depression, which perhaps does exceed 33 miles in length.

In our next two stages we shall have a better opportunity of becoming acquainted with this peculiar depression. We could have travelled equally well by its northern or its southern shore; but we chose the latter, because, according to the Tibetans, the grazing was better on that side. Here for a space we travelled between Nain Singh's route, to the north of us, and Littledale's, to the south. The routes of Bower, Wellby and Malcolm, and Deasy all ran to the north.

November 3rd. North-north-west of the camp we left a miniature lake, barely 100 m. in diameter, and thus of the same dimensions as the Harschu. In fact, these two lakes will have been connected together not so very long ago, indeed they may perhaps be sometimes united even now. Their water is fresh, so that they may be regarded as spring-fed pools, which get rid of their surplus water by some trickling rivulet. Immediately west of Harschu rises a terrace, 20 m. high at the most, with a steep slope next the lake. Immediately after that comes a second terraced step, about 10 m. high. From the top of the latter a steep slope of 30 m. leads down to level ground again on the west. Thus this is only a »pier-arm», quite narrow, but fairly long, stretching towards the south-east from the lowest slopes of the mountains on the north. It is built up of coarse sand and gravel, compacted into a hard solid mass. This pier is slightly curved in outline and concave towards the east; hence it forms the western boundary of the depression in which lie the present Harschu lakes. It narrows towards the south-east, and at the same time grows lower. Between its lowest extremity and the lowest terrace at the foot of the range on the south of the latitudinal valley there appears to be a break or gap. And at the foot of the northern mountains, but at a considerable height above the bottom of the valley, there are yet a couple of other terraces.

On the west side of the »pier» stretches a perfectly level expanse of hard, dry, white schor, a depression surrounded on all sides by sharply defined terraces. That water does sometimes gather there was evident from the deeply indented hoof-marks of the kulans, making black gaping holes. But at that time the ground was so dry and hard that our horses' hoofs scarce left any impression upon it. Next on the south rose a gloomy mountain-mass, with beach-lines fully 100 m. above the bottom of the valley, and thus dating from a time when this depression was still connected with the Perutse-tso. The western promontory of this mountain-mass stands beside the outlet of an important transverse glen, at the head of which was visible the nearest range on the south, dotted with separate patches of snow and known as Dandur. The corresponding promontory on the opposite site of the glen is known as Sogele.

On the other side of the schor expanse the hard gravel begins again, and is sprinkled with grass and scrub. After that comes another pier-like threshold, about 15 m. high; this is concave towards the west, narrowest in the middle of the valley, and widens out at the sides, where it gradually merges into the terraces which exist there. To the west of this threshold also there is an independent basin,

with a schor surface in the middle of it; otherwise it is steppe. Its western boundary is formed by a third »pier» or threshold, running like the others across the valley. It is about 10 m. high and on the east presents one unbroken slope, but on the west its slope is divided into two sections, 4 and 6 m. high respectively; and after that comes a fresh pier 10 m. high. Between these two piers, lying thus close together, there occurs a long, narrow hollow, in the lowest part of which is a little pool, about 30 to 40 m. in diameter and known as the Makuin-tso (fig. 121). Thus we had crossed over four successive piers and independent miniature depressions. How these so emphatically defined thresholds originated, it would be difficult to say; though hint is given by the fact of the ground falling somewhat from east to west, a fact a confirmed by the hypsometrical instruments. For the camp at Harschu we found an altitude of 4454 m.; for the summit of the fourth and most westerly threshold an altitude of 4443 m.; and for the shore of the Luma-ring-tso 4434 m., after which the ground rises again slightly. These terraces will therefore be old strand-ramparts, which were successively formed as the lake retreated westwards.

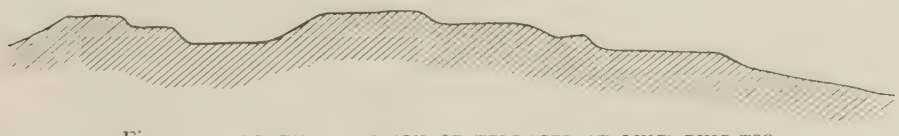


Fig. 121. VERTICAL SECTION OF TERRACES AT LUMA-RING-TSO.

From the top of the fourth and most westerly terrace we had an uninterrupted view across the Luma-ring-tso and its basin, then for the most part dry. According to the aneroid readings given above, the difference in altitude between the top of the terrace and the lake-side only amounts to 9 m.; this is however too little, the error being due to the moment of inertia of the instrument. As one could see with the naked eye, the difference of altitude is much greater, perhaps 30 m. The slope from the terrace down to the lake is however very gentle, and this again is divided into several step-like sections, four being especially noticeable. We traced their continuations all the way to our camp at the end af the day, — dark, horizontal lines immediately on our right and inclosing the basins of the Luma-ring-tso and Tsolla-ring-tso. But farther west they grew increasingly more indistinct, and at the point where we proceeded north from the Tsolla-ring-tso, and thus must have crossed over them all, they came entirely to an end; wherein we may discern yet another proof of what I have said above as to the relation in which the prevailing wind stands to these strand-terraces. It is in the extreme eastern part of the basin of the Luma-ring-tso and Tsolla-ring-tso that they are most developed, for it was there that the wave momentum was greatest, and the farther you go west the smaller was that force. The uppermost of the four terraces is the biggest, — evidence of the lake having persisted a long time at that level. Above that line we did not see any others of a similar character at the foot of the mountains.

We next travelled towards the north-west along the foot of the lowest strand-terrace and over hard, level gypsum soil. Scrub was growing at intervals, and here we passed a little belt of balghun bushes. The surface was frequently furrowed by

eroded rivulets coming from the northern mountains and breaking through the terraces. On the north rose two dome-shaped protuberances, one on each side of the outlet of a transverse glen. Their names are said to be Jaruk-mena on the east and Jaruk-doma on the west. Close to us on the left there now appeared big expanses of gypsum, rising into mounds and pyramids, as beside the Lakor-tso, or forming — and this is here the commoner — platforms and terraced elevations like those beside the little salt lake west of Lakor-tso. The latter generally have quite level surfaces and gleam white like sugar or snow. On the space between our route and these level expanses there was a sprinkling of wretched grass, with springs breaking out in several places, some giving rise to little pools and marshes, others to tiny rivulets that soon dwindled away, though not before they had cut a path in a glen-like sort of trough between two gypsum expanses; through this hollow we again caught sight of the extreme eastern end of the Luma-ring-tso.

In the S. 38° W. rose a more conspicuous eminence belonging to the southern range. This was now more distant, but fairly massive and pierced by several short transverse glens. It was said to be known by the name of the Dembe-tsare and appeared to be divided into two parallel chains, of which the nearer one was darker and more irregular in outline, the farther one more compact and higher and of a light red colour.

After that we had on our left the last portion of the Luma-ring-tso. It turned out to be a very insignificant lake, hardly deserving in fact to be called a lake at all; for it cannot be more than 2 km. long and at the most 100 m. broad, and is drawn out east and west, this shape being prescribed by the conformation of the latitudinal valley. The main body of the lake lies on the northern side of a more extensive gypsum expanse, which has been exposed so recently that its surface is still innocent of the usual irregularities, being perfectly smooth. There were also said to be several open sheets of water in the southern part of the gypsum expanse, although we failed to see any. Possibly the water-level was then exceptionally low, whereas in the rainy season the lake will spread out and cover the whole of the level gypsum expanse.

Next we crossed over a pier-like spur, of the same appearance and material as the preceding; its extremity pointed towards the north-north-east and was about 6 m. high. It constitutes a projection from a table-topped bluff, a sort of low independent terrace between our route and the western part of the lake. At its northern foot were some small pools and marshes. A little bit farther west we passed yet another long, narrow platform-like elevation, with strand-terraces still discernible on its southern face. From the top of it we commanded an uninterrupted view of the next lake, the Tsolla-ring-tso, which is several times bigger than the Luma-ring-tso, though still small. The two lakes are separated from one another by a flat isthmus, rising but little above the water and very marshy. To travel along it is impossible. During the rainy season this strip of land is said to grow continuously narrower, though our Tibetans could not remember that the two lakes ever joined and formed one sheet of water. Their statements prove however one thing at any rate, that during the rainy season the now exposed level gypsum expanses are inundated, for at the time we passed the water did not touch the isthmus, it only covered

those parts of the lake-bottom which had been recently overflowed. Nevertheless the boundary between the two is very sharply drawn and very distinct. Both the Luma-ring-tso and the Tsolla-ring-tso are constantly shrinking, and oscillate but slightly in the different seasons. At the time when we saw them they had pretty certainly not reached their lowest level, but they would go on dropping lower and lower during the winter and spring, and would rise again after the first rains fell in the summer.

Fig. 122. TSOLLA-RING-TSO; CAMP CXIX.

The Tsolla-ring-tso, the northern shore of which we now followed, is likewise elongated in shape. Close to that shore there are several long, narrow silt islands, running parallel with the beach and its terraces. We also saw others of the same kind out in the middle of the lake, a proof that it is very shallow, and possibly its water all evaporates before the first rains come. We pitched Camp CXIX at the foot of the lowest strand-terrace. In a pool containing spring-water, close beside the lake, we surprised eight wild-duck. The strip of shore consisted of ooze, very treacherous and very dangerous: we nearly lost two horses there, it costing us a great effort to save them. We had therefore to keep the clumsy camels tied up during the night.

The top of the lowest terrace, which only rises a couple of meters above the surface of the lake, as well as the whole of the flat shore, is covered with a sprinkling of knobby fragments and pieces of rock, a calcareous tufa.

Domtsching-garnak is the name of the mountains to the south. The bottom of the latitudinal valley between their base and the base of the mountains on the north is in great part occupied by the Tsolla-ring-tso and its level gypsum expanse. Lumpy gypsum formations were not so common here as beside the Luma-ring-tso.

On the 4th November we made quite a short stage, keeping along the northern shore of the Tsolla-ring-tso until we reached its western end, where the boundary of the region of Rudok is said to run. There we were met by some fifty

to sixty armed men, with yaks. The shore-line at that side is rather irregular and ragged, being broken into a great number of small bays, lagoons, and peninsulas, the latter always stretching from east to west. This lake was nowhere frozen, its water being very salt; but along the shore are found a number of ice-bound pools, which owed their existence to springs and were surrounded by wretched grass. Fragments of calcareous tufa were common everywhere; in fact, they were sometimes so numerous that they impeded our advance. There the only surviving strand-terrace of those which I have mentioned was the lowest one, and it runs quite close to the existing water-line. Of the upper terraces we could see nothing except faint fragmentary traces in one or two places. The lowest terrace, spurs of which we crossed over at intervals, is low, and possibly the lake, when at its highest, reaches right up to its foot. In the south-west rose a dominating bluff called Gogin-gila, with just a trace of snow on it. The northern mountains are cut through by a transverse glen, overlooked on the west by the peak S3. The lake narrows towards the west, and finally comes to an end altogether, and is succeeded by a level gypsum expanse. At the western end of the basin, where we formed Camp CXX, though the grass was extremely thin, we found however a small isolated sheet of water. Here again we encountered mounds and pyramids of gypsum, though the area covered by them was but small.

Of the names that appear in the western parts of Littledale's map, the men of Rudok knew only three, namely Alung-gangri, Roksun, and Rundor; the others they said they had never heard speak of. This may of course have been due as much to their own ignorance as to misconception on the part of Littledale. They also gave me four other names as belonging to the northern route which we were now about to follow — names that we did not come across, namely Jaghing, Bagma-didschi, Lam-lung, and Danse. Our informant was a hostile chieftain; but the escort were all friendly disposed and pleasant men, whose statements may, I think, be implicitly relied upon. They called the little lake, beside which we pitched Camp CXX, the Oring-tso and the next one to the west of it the Batsa-singi. They were also acquainted with the name of Tsolla-ring-tso, and added that that lake lay farther east, as in fact it did. It is however strange that they should have two different names for the same sheet of water in one and the same depression, unless indeed this is only a repetition of what holds good in the case of the Perutse-tso, and the two different names apply to identically the same lake, so that what the eastern Tibetans call the Tsolla-ring-tso is known to the Rudok Tibetans as Oring-tso.

CHAPTER XV.

THE BATSA-SINGI AND THE DETSCHE-TSO.

On the 6th November we turned our faces due north, and made for the outlet of a transverse glen, which there gaped open towards us. In it we found a relatively plentiful supply of grass, on which our caravan animals had pulled themselves together a bit during the day's rest that we granted them on 5th November. The surface rose, at first slowly, but afterwards more noticeably. After crossing over a belt of lumpy, barren white gypsum, we came to hard saj, that is, thin gravel resting on a firm, consolidated substratum. Even before we entered the glen, we encountered a little grass and scrub. The higher we ascended, the more comprehensive grew the view that we obtained of the interesting latitudinal valley which we were now leaving behind us; its bottom was filled with an unbroken chain of small salt pools and gypsum depressions. In the west the basin of the Tsolla-ring-tso is bounded by a steep, very energetically defined escarpment, 15 to 20 m. high. We were able to follow it for a considerable distance along the foot of the northern mountains; it gradually grows lower and at length disappears, after shading off, as it appeared from the distance, into an ordinary river terrace. When we got high enough up to see over this impeding obstacle, we caught sight, to the west of the lake of Batsa-singi, of a lake-basin of precisely the same type as those which I have already described, only it seemed to be considerably longer, stretching to a great distance to the west. It is not very broad, rather narrower than the Tsolla-ring-tso. Its bottom consists almost entirely of a level deposit of gypsum, there being very little water at that season of the year. Such pools as the basin did contain were confined exclusively to the southern side, pretty close to the foot of the southern mountains, where they formed as it were a long canal, broken however in several places. In this respect therefore the Batsa-singi is distinguished from the Luma-ring-tso and the Tsolla-ring-tso; for in them the open water is near the north edge of the basin. The Batsa-singi also possesses undoubtedly a terrace or beach-line at its eastern end, developed at the least to an extent equal to those which we saw immediately west of Camp CXX, so that here again a transverse threshold separates the two lakes. The isthmus between them is however only about one kilometer across.

From Nain Singh's description of this region I cannot quite make out clearly where it was he travelled and what it was he really saw with his own eyes. According to Trotter's account of his itinerary, he made his headquarters from the 25th to the 29th August at Hissik Chaka; and to the south-west and west-south-west of that little salt lake we find on the map a very long (33 miles), narrow lake, extending east and west, and corresponding beyond doubt to the salt depressions in the latitudinal valley which I visited. The only guidance we find in the text is as follows: »The strangers fortunately turned out to be residents of Gargethol, the place the Pundit was aiming at reaching, and which lay about a day's march to the south-west of Hissik Chaka. On the following day (August 25th) they travelled together to Gargethol, where they found a large encampment of Khampas . . . Between Gargethol and the Champa district of Shankhor, on the south, is a place called Gegha, where a large fair is annually held in July and August. On the 29th of August the Pundit returned to Hissik Chaka. . . .»*

The name Gargethol appears on the map to the south of the long lake, between it and a big mountain-range, which continues immediately north of Thok-Jalung. Ghega is placed on the southern shore of the lake. Thus, if the Pundit visited both Gargethol and Ghega, he must, starting as he did from Hissik Chaka, have gone either round the lake or in some way across it; but his itinerary just at that spot is not shown. On the northern shore we find on the other hand the name of Luma Ring Chaka, and this must be identical with my Luma-ring-tso, as also the name of Yondon Chaka, which I did not hear mentioned. The most important thing however is that the map shows the lake in detailed outline, and it would have been gratifying to have had some account, however brief and sketchy, as to its characteristics. Nain Singh's map does not agree with what I saw. There was no doubt a time, as we have seen, when all these depressions were connected together and formed only one lake, and that would have approximately the outline of the lake shown on Nain Singh's map. But is it conceivable that the lake has shrunk and dried up to the extent suggested within the thirty years or so that have elapsed since the Pundit's visit? He was there in the end of August 1873; it was the beginning of November 1901 when I was there. Let us assume, that the configuration on Nain Singh's map of the lake really is correct, and possesses the same degree of reliability as most of the other information which he gives; then there are two ways in which the differences between his map and mine may be explained. We may accept the explanation that the lake has possibly shrunk to that great extent during the thirty years' interval. On the whole however the tendency of the climate of Tibet to grow drier and drier is one that is only appreciable over a long period of time. Within that period there may be oscillations of shorter intervals, that is to say of shorter duration, and cognate with the Brückner periods. If we adopt one of these shorter periods, then a space of 30 years is quite sufficient to give rise to the changes which, according to Nain Singh's map, have taken place in the big lake. Under these circumstances Nain Singh will in the year 1873 have found in the latitudinal valley one large continuous lake, a lake about which his text does

* *Journal of the Royal Geogr. Soc.*, vol. XLVII. 1877.

not however say a single word, though it is shown on his map. Since then that lake has shrunk year by year, until by the year 1901 nothing of it was left except the detached and extremely insignificant, as well as shallow sheets of water, the Harschu, Luma-ring-tso, Tsolla-ring-tso, Oring-tso, and Batsa-singi. In this there is intrinsically nothing remarkable, when it is recollected that a rise of a couple of meters would be sufficient to unite at all events the middle ones of these sheets of water. But it is more difficult to explain the existence of the transverse thresholds and the sharply defined strand-terraces, which under no circumstances could be formed in the course of 30 years, unless they were *à priori* existent, and were originally nothing more than moraine ridges which date from an even earlier epoch, and have been gradually left behind by the ice-stream as it step by step retreated. This possibility is by no means inconceivable; but the problem cannot be solved without fresh and exhaustive investigations, which I had at that time no opportunity to make, especially as it was then winter, with the thermometer down to — 20° C.; besides, grass was seldom to be found and the strength of my caravan animals was exhausted.

The other explanation is to be sought in the fact that Nain Singh visited the region in the end of August, whereas it was the beginning of November when I was there. I have already mentioned, that the isthmus between the Luma-ring-tso and the Tsolla-ring-tso narrows very considerably during the rainy season, owing to the fact that the level floor-like bottom of each lake is then completely under water, which also rises and encroaches upon the isthmus from both sides. It was this circumstance which I took to be a proof of the great sensitiveness that these shallow lakes exhibit to the varying amounts of rainfall during the course of the year, in that in the actual rainy season they are biggest, but contract during the winter and spring. We have assumed, that all the salt lakes of Tibet are drying up, but different lakes are at different stages of desiccation. Some, like the Selling-tso and the Lakor-tso, are still constant, even though their level does vary with the seasons; others, like the Luma-ring-tso, dry up in all probability in the spring, but fill again at the beginning of the rainy season; others again have dried up for good, leaving merely a salt-pan behind them — of these we shall come across examples presently. The Luma-ring-tso and its neighbours are seasonal lakes, and exist only half the year. They are thus well advanced towards those of the third category, namely the class of lakes which have entirely disappeared. Nain Singh however — and this is the point I wanted to come to — visited the lake just at the height of the rainy season, when the quantity of water in these elongated depressions is greatest. I found, long after the conclusion of the rainy season, a mere chain of wretched salt pools where he witnessed one single long continuous lake. We cannot therefore assert without qualification that his map is in this respect incorrect, because the differences within the thirty years admit of a perfectly natural explanation. But in this instance we have a proof, without looking for it, of how important it is that pioneers should in their journeys make and record as accurate measurements as they possibly can. A traveller who visits, say, the Panggong-tso for a month, and makes a number of reliable measurements, is far more entitled to the gratitude of the scientific world than a man who traverses the whole of Asia

without bringing home a single reliable figure. Bower's and Littledale's statements, for example, are far too scanty to allow of scientific conclusions being drawn from them, and even though we are bound to accord our heartiest admiration to these geographical pioneers, we are at the same time constrained to recognise that their journeys are not exactly of especially great value. And the same remark applies in a high degree to Prschevalskij, Roborovskij, and Kosloff, though in other domains they have done much very excellent work, and accomplished a good deal for geography. Still we expect more from modern explorers than we do from a Fa Hian, a Hwen Tsang, or a Marco Polo.

To judge from Littledale's map and Nain Singh's, I should for some days be travelling north of the route of the former and south of the route of the latter, and should then cross over Nain Singh's route, and after that have them both on the south; finally at Tso-ngombo I should again come into contact with Nain Singh's route for a few days.

Meanwhile the basin of the Batsa-singi disappeared like a long white plain behind us, as we entered the outlet of the transverse glen and climbed up it towards the north-north-west. Its watercourse possesses fairly rounded edges, and it appeared to be a long time since water flowed that way; in any case it is very seldom that large quantities of water do make their way down it. The glen is broad, and the surrounding mountains relatively high, though their outlines are for the most part rounded. Hard rock was rare. Then follows a belt of soft, sandy soil, covered with an abundance of grass, the best in fact that we had seen since leaving the Perutse-tso. Unfortunately there was no water, so that we were unable to encamp there. In a large open expansion of the glen, under the pass, we passed on the left three small crescentic dunes, not more than 3 m. high, which turned their steep, leeward sides towards the north-east. They are arranged in a straight line: that is to say with a hard wind the sand would be able to travel from the first to the second, and from the second to the third. Thus they lie in one and the same wind-furrow; but neither to the south-east of them nor to the north-west was there discernible the smallest tendency to even the beginnings of dune-formation. Taking the line through the highest point of the crest of each dune, they stretch from south-west to north-east, the reason of this being, I dare say, that these mountains deflect the west wind to the south-east, and the origination of dunes just at this spot is explicable solely on the ground of the favourable locality. But immediately south-west, as immediately north-east, of this chain of dunes those favourable conditions no longer exist, and the formation of dunes is prevented either by the character of the surface or by the relations of the wind. These three dunes must therefore be looked upon as immovable and stationary. From the first one, which lies farthest south-west, sand can indeed be wafted to the middle dune, and from it farther to the one in the north-east; but from this last, which may be regarded as having reached a stationary altitude and unalterable dimensions, the sand is carried farther towards the north-east up the mountain-slopes, without getting a chance to stop and form fresh dunes; the reason being no doubt that that part of the glen and its slopes are too directly exposed to the strong wind, which sweeps away everything in its path. Thus our three dunes can no more grow in altitude than they can advance

farther in the direction in which the wind blows; but they are for all time inflexibly fixed both as to position and as to dimensions, that is until such time as disintegration shall have altered the surface relations of the neighbourhood. Another proof of the immobility of these dunes is furnished by the fact that the first one, farthest south-west, is slightly grassed on the outside, and consequently its movement is in this way partly arrested. The other two dunes are however still bare of grass; from which it is to be inferred, that the interchange of sand is so active that grass gets no opportunity to grow on their changeable and unstable surface. They are thus more exposed to the wind, whereas the first dune gets a slight degree of shelter from the mountains on the right of the glen, although they are very low. The sand of which the dunes are built up is certainly derived from the weathered products of the spurs of these mountains and their south-western slopes, which go down gently towards the Batsa-singi. It is not conceivable, that the sand should come from any more distant locality, not only because the whole of the bottom of the valley for a long way towards the west is occupied by the last-mentioned lake and its gypsum expanse, but also because we always found the atmosphere clear, even when it was blowing a perfect gale. However, sand-dunes are, as I have already said, such a great rarity in this region, that they involuntarily arrest attention when one does come across them; in fact, to me they seemed almost to convey a sympathetic greeting from the boundless sandy oceans of East Turkestan and the Gobi.

The pass is rounded and comfortable, though the last bit of the acclivity is distinctly felt, without however being strictly speaking steep. The summit is crowned by a cairn of stones. The altitude is 4858 m., showing an ascent of 450 m. from the bottom of the valley. The glen that descends towards the north-west is steeper and narrower than that on the south, and is joined by several side-glens, one of which, coming from the east, is of considerable dimensions. From the pass we perceived to the N. 9° W. a minor snowy peak. In about the same direction there appeared also the western end of a salt lake, situated in a fresh latitudinal valley more to the north, and parallel to that in which we had hitherto travelled, and which leads, I was told, straight to Rudok. As far as we could see from the distance, the new lake appeared to possess about the same characteristic traits as that which we had just left behind us, being extremely flat, for the most part dried up, and with a gypsum deposit, gleaming as white as snow, where the lake formerly was. This lake is said to bear the name of Detsche-tso, after the pass of Detsche-la, which we had just crossed over. Farther towards the north-east there is said to be yet another lake, called Nas-tso, though we were unable to see it from the pass.

Camp CXXI was pitched in a little expansion of the glen known as Dungga, though according to others as Jagäng. Its absolute altitude was 4721 m. In it is a spring, which had given origin to extensive sheets of ice. From yet other springs there issued a little rivulet, which made its way through a transverse glen towards the north, though the glen cuts off only an insignificant portion of an offshoot from the main chain that we had just crossed over. Kulans, partridges, and wolves occurred in this region.

The range consisted here of some sort of severely weathered greenstone, with an indeterminate dip; on the south side it appeared to go down steeply towards the south, and on the northern side towards the north-west.

From the top of this separated portion of the range, to the north-west of our camp, we obtained an excellent view of the northern latitudinal valley. It is bounded on the north by several parallel ranges, none of them very high; it was in one of these that we saw the little snowy peak which I have just mentioned. Across the Detsche-tso we had an uninterrupted view. It is not so very small; and we were able to make out distinctly varying shades of colour in the concentric rings round its existing shores, an indication of its continuous shrinkage. To the north-east we caught, through openings in the mountains, glimpses of several white expanses, pretty certainly the bottoms of dried up lakes.

Fig. 123. HILLS AROUND CAMP CXXI.

On the 7th November, as on the days preceding, we enjoyed good weather, excellent weather, with a very gentle wind; in fact at noon we felt it uncomfortably warm when exposed to the direct rays of the sun. All day long, and we covered 22 km., we did not come across a single drop of fresh water, nor did we see either tents, or flocks, or herds, though once or twice we did observe signs of old encampments.

When we started again we proceeded first towards the west-north-west, until we reached a flat pass, quite close to our camp and only a few meters above it. North

of it was the hill from which we had obtained our view the day before; on the left, that is to the south, was a range of moderate height, with dome-shaped and pyramidal peaks and protuberances, and a tangle of deeply incised watercourses winding round them, then running together and making their way down to the main channel. We followed this last down from the pass, going towards the north-west. This watercourse is deep and energetically eroded, and is bordered by abrupt, sharply defined scarped terraces. Beside it some bushes were growing, and in them hares and partridges were common. The glen trends gradually towards the north-west, and once more afforded us a view across the Detsche-tso. The mountainous regions nearest to us on the south are called Galtser, those farther away Dschogtsom, though both are probably rather the names of grazing-grounds. Quite close to the northern shore of the lake is a rather small black range called Durtse, which culminates in the peak T_3. The main range on the northern side of the latitudinal valley is said to be called Dagdschu. It is of course impossible for me to vouch for the accuracy of these names, as I had no opportunity to control them.

Fig. 124. VIEW FROM THE DETSCHE-TSO.

After we issued from the glen, we left its watercourse on our right and watched it disappearing in the direction of the lake, though it did not appear to reach all the way to it. We crossed over any number of rivulets coming from the mountains on the south; some of these were bordered by very awkward escarpments. Except for this the ground, consisting of coarse sand or fine gravel, was hard and excellent for marching on. We approached the lake at an acute angle, and then kept along its shore and not very far from it. The whole of the eastern part of the lake-bottom is occupied by a single gigantic deposit of gypsum, dotted over with pyramidal elevations; otherwise the desiccated portion is level. In this lake again, as in the preceding similar lakes, these knobs and pyramids, often reaching

a height of several meters, occur only in those parts of the bed which are at a great distance from the existing lake. The gypsum between the surviving sheets of water is level, owing to its having been exposed at relatively so recent a date that wind and weather have not yet been able to sculpture its surface; but in the case of the deposits that lie farther away, and consequently at a higher level, they have been able to produce some result. These gypsum formations possess however but little power of resistance, and after a sufficient interval of time has elapsed they will be entirely planed away. Hence we did not observe them at any great distance from the Lakor-tso and the other lakes. They are evanescent phenomena. After that we came to the open lake, which, although in itself small, is nevertheless bigger than the open surfaces of the Luma-ring-tso and the Tsolla-ring-tso. Close along the entire southern shore of the lake runs a narrow fringe of pure white gypsum, interrupted at one point only by an isolated pool of water. There is a similar belt of gypsum along the northern shore, but it appeared to be broader. Shortly afterwards we passed the broadest part of the lake, after which it narrows again towards the north-west. This lake, like all the others on the high plateau of Tibet, is long and narrow, and for the whole of the next day we continued to follow its shore. On the whole half the lake-basin was covered with water, the other half being white gypsum. The expanse of gypsum is broadest in the east. According to my hypsometrical instruments, this lake lies somewhat lower than its predecessor, or at an altitude of 4346 m.; but its relatively greater volume would appear to indicate, that it has not yet advanced so far towards extinction as its more southern neighbours, though in this matter the altitude above sea-level is of less moment than the inflow of water. Although the lowest slopes of the mountains on the south reach all the way down to the lake shore, there are no old strand-terraces or beach-lines visible on them, this being, I dare say, due to the fact that that shore is relatively sheltered. Farther on however they show quite distinctly in a more exposed position on the northern shore.

Passing over a threshold between the foot of the mountains on the south and a small free-standing butte, we reached a spring, the rivulet from which had given rise to a ribbon of ice. The altitude was 4470 m., and the name of the place Tsebu, while a black bluff to the S. 52° W. was said to be Schuschü. The grazing in this locality was comparatively good.

Porphyritic tuff cropped out in a watercourse near the shore, and a little bit farther on a red variety of rocklike conglomerate. The strata were indistinct; but the horizontal stratification was easy to make out in the beds of gypsum beside the lake.

November 8th. Continuing on towards the north-north-west over ridges and offshoots from the mountains, we soon came in sight of the lake again. In one place this appeared to be cut in two, in that it consists of two basins separated from one another by a marshy tongue of land, both short and narrow, just as is the case with the Luma-ring-tso and the Tsolla-ring-tso. All day we travelled quite close to the southern shore of the western basin of the lake. Here also, except for one or two short interruptions, the lake is encircled by a girdle of gypsum, with small elevations like platforms and pyramids. Between these and beyond them we saw everywhere open water; while on the northern shore there is an even

broader expanse of gypsum. The background in that same direction, that is towards the north, consisted of a minor round-topped range, seamed with an endless number of miniature glens and watercourses. At one place the lake contracts a good deal, in fact it almost seemed to come to an end; but we soon discovered that a narrow sound connects it with another basin farther west. The shore-line is here very irregular, bays penetrating deeply into the gypsum area and alternating with long, narrow peninsulas. In one or two places there were tiny meadows of fairly good grass stretching between the gypsum platforms; but they were inaccessible because of the water and the marshes. We pitched Camp CXXIII beside a frozen brook that enters a western bay of the lake and at an altitude of some meters above its level. Quite unexpectedly we found that the water in this lake was fresh; though in the eastern basin of the same lake, the Detsche-tso, it is salt. In the middle of the western lake we were able to detect a slight saline flavouring, but in the extreme western end the water was perfectly fresh. A closer investigation showed however that there was nothing remarkable in this, for the western basin possesses an outflow into the eastern basin. Indeed water was entering it even then, as we observed near our camp, not only from the little rivulet from the spring, but also from a number of other springs, which bubble up on that same shore, as well as, finally — and herein lies the key to the puzzle, — from a not inconsiderable river which empties through the northern shore. The brook will certainly carry a much bigger volume during the summer than it was carrying then, perhaps as big a volume as the northern river; but on the other hand it may happen that the lake rises then so high that its two basins are connected across the low, marshy isthmus, and possibly the entire lake is then salt. Under those circumstances the western lake, which is in itself insignificant, will only turn fresh after the two lakes have become separated, and after the western lake has been refilled by the river, springs, and brooks. This view is supported by the fact that the water grows salter towards the east, though even there the areometer recorded a sp. gr. of only 1.0015. A vast number of wild-geese, and also of wild-duck, were disporting themselves on the northern shore, where several strips of green meadow were conspicuous amongst the gypsum deposits, and where there is also possibly vegetation at the water's edge. This lake would appear therefore to lie in the path of one of their routes of migration.

Fig. 125. LOOKING S 88° E FROM CAMP CXXII.

Fig. 126. CAMPING.

The moderately high range on the south is said to be called Jagar or Jagargogma. The wind was this day less violent than usual. The place where we encamped was known as Döllu-tschuga.

On the 9th November we were to pass out of this latitudinal valley and go over into a fresh one farther north; so that both orographically and hydrographically this stage offered a pleasing diversity from the otherwise rather monotonous landscape. We proceeded first north-east, then north-west, but on the whole bore to the north, and were consequently led by our men of Rudok farther and farther away from their forbidden country. From Camp CXXIII we saw the valley in which the two last-mentioned lakes are situated continuing on towards the west, though it no doubt subsequently inclines as usual towards the west-north-west and north-west. Its continuation appeared however to be narrower than usual, for the offshoots from the mountains on both sides reach down to very near the middle of the valley, their bases approaching quite close together. It is this valley that is traversed by the brook of Döllu-tschuga. We even saw the outlet of the valley bearing S. 70° W. from our camp; it too is rather narrow and contracted, so that the valley actually appears to debouch upon the broader basin in which the two lakes are situated. From this it results that the range which borders the narrow part of the latitudinal valley on the north, the part lying entirely west of Camp CXXIII, describes a rounded curve towards the north-east before it continues towards the south-east. There is undoubtedly a convenient route to the west through this latitudinal valley; but I had no reason to find fault with the more northerly route by which the Tibetans led us, for it traversed unknown and fairly interesting country.

Following the extreme western dried up part of the lake, we had immediately on our right thick and extensive sheets of gypsum, studded with the usual platforms, pyramids, and mounds, all of snowy white gypsum. At intervals we crossed over little tongues and offshoots of this formation. Farther on the ground became more marshy and small sheets of water gleamed out amongst the expanses of gypsum. The presence of sheets of ice revealed the fact, that the water there was fresh. Although the wild-geese were frequently within shot, yet as they always kept to situations in which they were entirely surrounded by water, we left them alone, because in any case we should have been unable to fetch them.

We now bore more to the north-east. Down the flanks of the mountains on our left came various watercourses, clearly defined in the gypsum, though not very deeply incised; it is only after rain that they carry water. Next we skirted a bay of the lake penetrating towards the north-west. It was only close to the shore that it was frozen hard enough to bear; elsewhere the ice was very thin, the result of the past night's frost, when the thermometer had dropped to — 24°.3 and the air was perfectly still and quiet. Here again a large watercourse enters the lake, though it was at that time perfectly dry. Turning away from the shore, we proceeded east along the foot of a ridge, or rather a low portion of the range that borders the latitudinal valley on the north. On the southern side of this ridge we observed four very distinct and beautiful old beach-lines, the ones at the top and the bottom being the most energetically shaped; the former was about 25 m. above the surface of the lake. Thus here again we find the old beach-lines solely and alone on that

shore which was more directly exposed to the westerly or south-westerly wind and to the action of the waves. But the lake was never especially big, even when its level was 25 m. higher than it is now; but it formed at all events a sufficiently extensive sheet of water to give rise to strand-terraces, though their formation was not possible on the western or southern shore. How matters stand on the northern shore, I was unable to ascertain, owing to the great distance, but in all probability there are beach-lines all the way along that side. From that point of view, it would have been more instructive to have travelled on the north side of the two lakes, as well as shorter, but the grazing there was said to be inferior. The strand-terraces are gapped by a great number of energetically excavated watercourses, looking like crevices and fissures slashed across the mountain's flanks.

At length we left this lake region definitively behind us and climbed up to an unimportant threshold in the northern hills, whence we obtained our last look across the western part of the lake. To the S. 40° E. appeared the extreme little promontory belonging to the range that borders the lake on the north. At its foot is a grassy plain, sloping gently down towards the lake, and then follows a chaos of alternate sheets of water and gypsum formations. In the shallow parts the water, owing to the white gypsum underneath, assumed a shade of light green.

From the top of the pass we beheld an unexpected sight, namely right down below us and east of the threshold a narrow glen, some 40 m. deep, carved through the beds of gravel-and-shingle, out of which the ridge is composed that possesses the four terraces mentioned above, and at the bottom of the glen was a river, bigger than any that we had seen for a long time, in fact considering the season it was unexpectedly large for the western part of Tibet. Since the gravel-and-shingle ridge forms, as it were, a connecting link or bridge between the higher parts of the mountains on the north of the latitudinal valley, this glen ought to be regarded as a transverse glen. Not very far from the point where we first caught sight of it, probably one kilometer, the river, after making a sharp bend, emptied into the northernmost bay of the lake. The existence of this river, which was then pouring into the lake a volume of some 3 cub. m in the second, accounts effectually for the freshness of its water, a thing which had at first puzzled me. On the mountain slope, immediately east of the river's mouth, three terraces were distinctly discernible, corresponding to three out of the four which I have mentioned above. That only three were visible at this spot may have been due simply to local peculiarities. These were even more energetically defined than the preceding, but the slope on which they were is more exposed to the beat of the waves from the west.

We went down to the river by a short steep slope, and then turned up the stream on its east or left bank. At the ford where we crossed over it the breadth amounted to 16 m., the mean depth to 0.30 m., the mean velocity to 0.75 m., and the volume to 3.40 cub.m. in the second. The stream was flowing in a lively and noisy fashion, carrying with it a great number of ice-sheets. It was only the relatively quiet bays that were frozen. The water was not perfectly clear, but its slight turbidity may be mostly accounted for by the collision of the drift-ice against the banks. Although all the conditions were favourable, there were said to be no fish in this river. The name given to it by the Tibetans is Ravur-tsangpo or Ravur-

schung, and it issues, I was told, from a lake to the north; this would explain the absence of water-marks on its banks. In fact, we have here a repetition of the same relations as in the Jagju-rapga, in which the Addan-tso and the Tschargut-tso moderate the river's flood and distribute its volume over the seasons of the year. It is possible later on in the winter that the level of the river drops below that at which we saw it, and that it stood then, on the 9th November, at its maximum. On Deasy's map, on which this river is entered, one of its branches, coming from the north-west, is shown as issuing from a lake, the Bum Cho, and a second as emerging from one of the usual desiccated basins of the lake. But Deasy had no opportunity, any more than I had, to follow the river up to its source, for our routes intersected on its bank, and whereas I left the entire system on my right, Deasy's route crossed over it and proceeded northwards. He may therefore be mistaken in representing the last-named basin as destitute of water, and it may in fact be most probable that the Ravur-tsangpo really does issue out of a lake; otherwise it would hardly have carried such a big volume of water in the winter, and had it not passed through a clearing-basin, the water would have been much muddier than it actually was. We may also take it, that the west branch does issue out of a lake, Bum Cho, while the eastern originates in springs in the dry basin, and this would explain why the water was not perfectly clear. The surface of the stream was then only very slightly lower than the ground at the bottom of the valley; but of deeply eroded scarped terraces there was not a trace to be seen. In fact the actual bank was frequently nothing more than a slight swelling, with a scanty sprinkling of vegetation.

Meanwhile we kept along the left bank towards the north-north-west. Although the glen widens out a little, it still continues to be only narrow. Its bottom is remarkably level and rises uniformly; yet it is so far noticeable that the water often broke over small cascades. On both sides the glen is shut in by gravel-and-shingle hills, those on the west being the bigger. Countless gullies furrow them on both sides, though they were then all dry. At a distance of 5 or 6 km. to the west-south-west rose a more dominating protuberance, called Jagar; evidently it belongs to the mountainous region which I have already mentioned as bearing that name. The river is generally divided into two or more branches, which embrace mud-banks between them. At a point where the entire volume was gathered into one stream we forded it, and then continued along the right bank. Just there the river was joined by a tributary coming from the west and bigger than any of the others; although it was dry, it evidently comes from a long way off. Higher up the river is broader and shallower, and is divided into several superficial undecided arms. We now left this river behind us, as also the range which it cuts its way through, and came out upon an open plain, one of the usual basins, with a dry clay bottom, flat and open, and stretching from north-west to south-east. This basin corresponds to Deasy's Kachon. He encamped in it in the same spot that I did, and his altitude, 4451 m., agrees remarkably with my own, which was 4447 m. From that point I travelled south of that part of Tibet which Deasy explored in such an accurate and admirable manner. Meanwhile however no further attempt can be made to explain the hydrographical position of the Ravur-tsangpo; for I now travelled away from

it, leaving it on the north, and did not come into contact with it again. The open basin too, in which we encamped on the 9th November, and which is in great part, perhaps indeed throughout its entire length, traversed by the river, is in a certain respect a puzzle. For its floor, from the point where we emerged upon it out of the mountains, is to the eye perfectly level, and consists of fine yellow clay, cracked occasionally into polygonal patches, and presenting a shallow, level, convenient surface like a parquet floor. After passing two such expanses we came to a third, and on it we encamped. This alluvial clay evidently owes its origin in some way or other to the river. The impression I got was, that there had once been a lake there, and that it has been filled up with sediment. It may also have been laid bare through the issuing river having cut its channel deeper and deeper, so that the lake has been gradually emptied. And this is all the more likely when we call to mind, that a river flowing out of a lake higher up, and therefore with clear water, would hardly be able to fill up a basin with mud, unless the current were swollen very appreciably during the rainy season through tributaries which it picked up below the lake. This however brings us face to face with the difficulty of accounting for the absence of older erosion terraces beside the river, and such there no doubt would be had the river deepened its bed step by step. But this river had no terraces of that sort. There is also another reason why we might expect to find them. The lake into which the Ravur-tsangpo empties itself has, as its old strand-terraces prove, dropped at least 25 m., and this would naturally intensify the erosive activity of the river, causing it to advance up-stream. As however erosion terraces are wanting, we are in a dilemma as to where the explanation is to be found. It is not permissible to suppose that the river terraces have been obliterated in the soft gravel-and-shingle, because at some point or other their former existence is always traceable, in however slight a degree. It is more probable therefore that the big salt lake into which the Ravur-tsangpo formerly emptied, and which filled the entire valley that is now broken up into a number of depressions, sank so rapidly in consequence of changes in the climate that time did not admit of the formation of terraces alongside the river. Under these circumstances one could not of course expect, that the fall of the river would be increased in consequence of the subsidence of the lake. The difference of altitude between Camp CXXIII and Camp CXXIV amounts to 55 m. The highest strand-terrace above the lake runs at 25 m. Hence this lake formerly sent out a bay to meet the mouth of the river, which would then be somewhere in the middle of the existing transverse glen. At that time the bottom of the lake would have the same slope that the river has now. When the lake receded southwards the fall of the river, following it, would not therefore be increased, but would remain the same all through the steady desiccation of the lake. The fact of the water in the western basin of the lake, into which the river empties, changing from salt to fresh is an entirely secondary phenomenon, dependent solely upon the fact that its western half possesses at any rate a temporary outflow into the eastern half, and it being the actual terminal lake, this is salt.

As for the northern lake, which has disappeared, and in the south-eastern part of which our Camp CXXIV stood, let us in the first place consider the character of its bottom. The whole of its southern part is occupied by the clay expanses

which I have mentioned, and they are very sharply demarcated on the south, next the sandy, gravelly plain, with patches of wretched grazing here and there. The northern half on the other hand consists for by far the greater part of a gypsum expanse, with the usual platforms and mounds, such as we always found in the vicinity of lakes that are more or less desiccated. Hence it cannot be doubted that there was once a lake there. Deasy's map even shows a few solitary pools of water still surviving from it. Of these I saw none; but then they may very easily have been hidden amongst the gypsum formations. The greatest difficulty is however to understand the relation which the river bears to this old lake. At Camp CXXIV we just saw the last river bend, but in the course of our further journey north-west down the latitudinal valley we perceived no further sign of any river, nor did we cross over any river-arm or even any dry watercourse, as indeed from Deasy's map we might have expected to do; but then, as I have said, our routes did not coincide. The impression irresistibly borne in upon me was that the river comes from the north, and at Camp CXXIV it turns to the south-south-east. In that case it need not of necessity be intimately connected with the old lake; but it is nevertheless probable that this lake was formerly a sort of »through» lake or marginal lake, which afterwards became cut off from the river. The extensive clay surfaces have conceivably nothing directly to do with the lake, except in so far as they occupy portions of its former floor; but they originated at a far later date and are pretty certainly being increased at the present time. If the Ravur-tsangpo should swell after heavy rains, it may overflow its right bank at this particular spot, covering the clay expanses with a thin layer of water, and dropping there its sediment. This would also help to explain how it is that no higher water-marks are to be detected in the valley, for overflow lakes act as an assured ventilator to keep the lower part of a river within certain bounds. Even then, at the time of our visit, those parts of the river which were next to Camp CXXIV were in places spread out like shallow lacustrine expansions. Finally, it is also very possible, that from time to time the rain-water floods from the southern mountains bring mud and sediment down as far as these level expanses.

CHAPTER XVI.

AMONG THE DESICCATED LAKES OF WESTERN TIBET.

The change which in the meantime had come over the scene was in a word as follows: we had crossed over out of one latitudinal valley into another similar latitudinal valley lying north of the former; both valleys run parallel to one another, from north-west to south-east; the mountain-range which separates them is especially low and unimportant where it is pierced by the Ravur-tsangpo; the rock at that point is a hard dense yellowish red limestone, dipping 55° towards the N. 60° W.; otherwise the narrow transverse glen is fenced in by beds of gravel-and-shingle, rising in very broken, but not very high, hills. From a point near Camp CXXIV we saw to the N. 10° E. a red round-topped protuberance, to the N. 14° W. a snowy peak (W_3), and to the S. 76° W. the peak V_3. The valley is broad and gives the impression of an open plain, with scanty grazing here and there. Kulans, which are in general fond of an open country, where they can see about them, were very common.

The names which were given to me by our Tibetan escort through this part of the country do not always agree with those which were given to Deasy; but it would be wrong to declare without more ado that they are incorrect, nor is it easy to say which are the more trustworthy, those given to me or those given to Deasy. From the latter's own account his guides were in a rather hostile mood, and that is indeed always the case in Tibet with a traveller who is *approaching* Lhasa. I on the contrary was marching away from Lhasa, and was on my way out of the country, and this would soften the inimical feelings of the Tibetans towards me, and for that reason they would have less hesitation in imparting to me the correct names of the geographical features than they would have in communicating them to a traveller of whose intentions they were intuitively suspicious. In those instances in which Deasy's names and my own are in agreement, we may be quite sure that they are correct, and this becomes even more certain when they are confirmed by Nain Singh or Bower. My Luma-ring-tso, for example, figures on Nain Singh's map as Luma-ring Chaka and on Deasy's as Lima Ringmo Chaka. *Tso* = »lake» and *tschaka* = »salt lake». This is consequently a name well known throughout western Tibet. And as for my escort, they were one of the last detachments that guided us to the frontier of Ladak, and were amongst the best guides that I ever

had in Tibet. The authorities of Rudok had of course selected men who, they were certain, would know how to guide us to Noh and Tso-ngombo without a mistake; they were men who *did know* the road; for the main thing was to get me out of the country as fast as possible, and it is therefore extremely probable that they also knew correctly the names of the geographical features. At Camp CXXIV I had moreover an opportunity to control their information. They told me that a moderately-sized lake, the Aru-tso, lay 4 or 5 days' journey to the north. The southern shore of this lake, which extends as usual from north-west to south-east, reappears on Deasy's map at a distance of 110 km. north-north-east from the last-mentioned encampment, and that, at the rate we were marching, would be exactly 4 to 5 days' journey distant. Bower discovered the lake, and called it, as Deasy also does, the Aru Cho. The altitudes given by the two English travellers are however essentially different; for, while Bower gives the altitude at 17,150 feet, Deasy puts it at 16,210 ft. Deasy's calculation is the more trustworthy. My guides declared that robbers haunt the neighbourhood of the lake, although their further statement, that the depredators came from such distant parts as Amdo, Naktschu, and Naktsong is not very credible. The year before five robbers had been seized by the authorities of Rudok in the narrow glen of the Ravur-tsangpo. To the north of our route there were said to be no settled inhabitants, not even a single tent. All our guides were acquainted with Jarkent (Yarkand), which they called Jartschan, and they knew also that caravans travel to and fro between that city and Leh.

After a cold night, in which the thermometer dropped to — 26.5°, we continued on the 10th November towards the north-west, through the big latitudinal valley, thus leaving Deasy's route again on the north, after crossing over it at three points. I got an opportunity therefore to correct the erroneous conception which he formed as to the part of the highlands that lies south-west of his route. On his map both the mountain-ranges and the principal valleys are shown running from south-west to north-east, whereas the prevailing direction is as usual from south-east to north-west. Along this latitudinal valley we covered what, considering our exhausted condition, was the unusually great distance of 32.2 km., and all the way to the Panggong-tso, with unimportant exceptions, the orographical arrangement remained the same. The valley is open and broad, and is shut in by low red ranges. The snowy peak to the north was soon hidden from our gaze. Sometimes we travelled upon hard gravel, sometimes upon level clay; as a rule the long, narrow expanses of clay lay on the right of our route. Beyond that, to the north-east, follow gypsum formations, and there, we were told, lies a little lake called Luma-sambo, though we did not see it. I cannot make out, as I have said, what relation it bears to the Ravur-tsangpo. Possibly this name applies only to a spring-fed pool, or a marsh, or the last surviving relic of a former lake. It answers to one of the six pools that are shown on Deasy's map. Possibly there does proceed, as Deasy implies, some river-arm from that region, though at the time of our visit that country was very arid; not a single drop of water was to be seen to the right of our route.

The district in which we encamped was stated by my guides to be called Tar-tova, though Deasy calls it Kangni. They gave the name of Gogtse to a

mountain bluff which we saw a long way off to the east, while the range on the north side of the valley is the Jabadi and its westward continuation the Ragtsang-gongjo; the range on the south, containing the peak V_3, is known as Särdschung-gongjo, and its westward prolongation as Pok-tova.

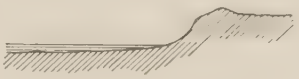


Fig. 127. POOL AT THE FOOT OF THE GYPSUM.

Then the character of the ground altered entirely, becoming nothing but gypsum, sometimes with pyramidal elevations and platforms and sometimes without. The lowest point that we touched in the depression had an altitude of 4436 m. After that we continued to ascend, though the rise was so gentle as to be altogether imperceptible to the eye. Quite close to the foot of the southern range we passed a couple of spring-fed pools containing fresh water, as well as one or two marshes lying amongst the gypsum formations. Some of these little hollows looked as if they could sometimes be filled with rain-water, while others are fed by springs. They lie ensconced between the edges of the gypsum expanses. In this region the grazing was extremely thin; but everywhere in the neighbourhood of water the ground was littered with kulan-droppings, and we observed several troops of those animals. Orongo antelopes and partridges were also common.

Meanwhile the mountains on the north and those on the south approached nearer together; in other words the valley grew narrower. Crossing the lowest slopes of the southern range, we entered the glen that opens out into the expansion of the depression in which so many signs all concurred in intimating that there formerly a moderate-sized lake existed. The dividing-line between the part of it that is covered with gypsum and clay on the one hand and the hills that I have mentioned on the other is very sharply drawn; but no old beach-lines were discernible. The bottom of the valley produces a large number of small bushes or scrubby plants, and amongst these hares were especially numerous. The bordering terraces are distinct, but very much rounded; in the middle of the watercourse there was not one trace of running water. Yet through this valley there once flowed a river which emptied into the lake that has disappeared. Deasy is in error in making the principal branch of the Ravur-tsangpo flow through this valley, in the upper part of which he places the above mentioned Bum Cho. There does indeed exist a lake but no river issues out of it; nor is it conceivable that water sometimes does flow down this valley, for if it did signs of it would remain in the river-bed.

The valley still continues to contract, and finally we passed a defile barely 50 m. broad. Its origin is due to the fact that a small elongated bluff rises immediately on the north side of the valley, but below the main range. This little bluff is divided into two by a gorge that begins in the main range. The principal valley continues faithfully towards the N. 60° W., expanding again a little; but it is still relentlessly shut in all the way by the adjacent mountain-ranges. At the defile the altitude reached 4518 m., and after that the rise as far as our next camp was so insignificant that it escaped our observation. Generally the surface appeared to be perfectly level, sometimes indeed it was as though it inclined towards the north-west. For some stretches we failed to detect any indications of erosion in the bottom of the valley; but hydrographically the whole of this valley, reckoning all the way

from the little lake, which we were to pass at some distance to the west-north-west of Camp CXXV, belongs to the region of the desiccated lake. It is evident that, at the period when the climate was moister than it is now, erosion played a much more active rôle in this valley than it does at the present time. For instance, here and there at the foot of the northern range we observed little hollow excavations or grottoes, which can hardly have been produced by anything else except running water, unless one prefers to ascribe them to an ancient glacier which made its way down this valley to the big dried up lake. But we saw no other evidences of glacial action, neither scratches nor moraines nor erratic blocks. In shape this northern range is quite unusual, in that it possesses neither gravelly screes nor heaps of detritus, but consists entirely of naked rounded heights. The rock is limestone, brittle and fracturing in several directions. At the narrow part of the valley it dipped 57° S., but elsewhere the dip was indistinct.

During the latter part of this stage our chief concern was, as so often happens in these mountainous regions, to discover drinking water. At last we had to send pioneers on ahead. One of these men found a small spring with ice-sheets round it in a transverse glen, another a frozen brook in the middle of the latitudinal valley, and there we pitched Camp CXXV at an altitude of 4,564 m. Beside this brook we rested a whole day, in order to give our Tibetans time to catch us up with their slower-footed yaks. This brook is also fed by springs; but it is just possible that it receives water from the lake that lies above it, although that is now destitute of outlet, this supposition being rendered probable by reason of the freshness of the water in the lake. On our arrival we found only a narrow strip of ice in the bed of the stream; but by the afternoon of the 11th November quite a little rivulet was flowing down it, though it was derived solely from melting ice. According to the Tibetans, such heavy rains fall in this locality in summer that it is often impassable owing to the soft and treacherous character of the ground. As for the winds, they were considered to be unusually quiet and favourable that year; generally however at that season they are so paralyzing that it is impossible to remain out in the open air when they are blowing. The locality is reported not to be visited by the nomads either in the summer or in the winter. When however we detected signs of three tents in the neighbourhood, we were told that they were due to vagrants and robbers. The name of the locality in which Camp CXXV stood is Tschuscher.

November 12th. For the greater part of the day the going was first-rate, the surface consisting of smooth, level, easy expanses of clay. We kept close along the foot of the southern range, the latitudinal valley broadening out a little. Over the top of the range on the north we caught sight of yet another range similar to it, and between the two is another latitudinal valley running parallel to that which we were then following, but narrower and essentially unlike it. The eroded watercourses that begin in the more distant range break through the nearer one — the same arrangement which we had already seen so many examples of on the Tibetan highlands. At the head of the northern latitudinal valley there rose a more dominating mountain, slightly sprinkled with snow. The more northerly valley eventually runs out into the one in which we were travelling. At length we ap-

proached the little lake, which was of the usual elongated shape, shallow, covered with thick ice, and containing fresh water. We kept along the southern shore, which was littered with any quantity of wild-goose feathers. The slopes of the southern range reach right down to the shore. Here the Tibetans, who declared as usual that it was an inconceivably long distance to the next spring, filled four sacks with pure glassy ice.

From this lake, which is said to be called the Muschko-tso, the ground slopes up towards a little threshold in the latitudinal valley, hardly noticeable, though it forms the western boundary of the lake. After that the latitudinal valley bends, at all events for some kilometers, towards the west-south-west, at the same time increasing in breadth; on the south it is bordered by a dark range, lightly sprinkled with snow. The slope of the ground is wonderfully gentle. But instead of continuing along the valley, our Tibetans pressed steadily on towards the west-north-west, keeping to the foot of the northern mountains, and making for a pass which we saw in them. The going here was very difficult, owing to the excess of gravel and to the great number of small but deep gullies with which the ground was cut up. One of these gullies was a good deal bigger than the others and had a double erosion terrace on its left side. A little beyond this we made Camp CXXVI at an altitude of 4,678 m., the place being called Lablir. We saw smoke rising out of an adjacent ravine and soon a couple of men appeared. Our Tibetans declared that they were robbers and that we ought calmly to shoot them down! As soon as they caught sight of us the strangers took to flight, and from the evidences that they left behind them at their camp, it was clear that they were only harmless hunters, who were out in quest of meat. And that there were nomads not very far away to the south was also clear from the circumstance that one of our guides procured us a couple of sheep and some milk, and next morning we saw, though at a considerable distance to the south-west, at the foot of the mountains on the opposite side of the big, broad valley, flocks of sheep and herds of yaks, as well as no less than half a dozen little columns of smoke curling up from as many different places. Thus the inhabited parts of Tibet lay to the south of us; the parts which we ourselves had traversed were uninhabited; and probably there were no nomads either to the north. In the middle of the big latitudinal valley we observed, to the south and south-west, extensive areas of yellow clay, the beds of transient alluvial lakes. The southern flanks of the mountains on the north of the valley still continued to be seamed with gullies and eroded rivulets for a long way to the west. The following were the names given to me as those of our immediate surroundings. A small dark mountain promontory at about 10 km. to the south was called Paramo. The biggest snow-capped range to the south, at a distance of perhaps three days' journey, was the Gangri-tsesum; its middle peak bore S. 35° W. The range which we were about to cross was the Pagelung. To the N. 31° E. rose the most westerly of the snowy peaks which we had seen at various times during the preceding days.

November 13th. We ascended the gravelly slope until we reached the outlet of a small glen, narrow and filled with gravel and shut in on both sides by bare cliffs. After that we travelled west-south-west, and it soon turned out that we were

in a fresh latitudinal valley, separated from the big one by a steep minor range. The grazing there was so thin, that it barely tinged the surface yellow; as a rule the ground was perfectly barren. We then climbed north-westwards up to a flat pass having an altitude of 4872 m. There we came across two sheepfolds built of stone, convex as usual towards the west, a proof that nomads do sometimes visit that locality. On the summit of the pass the grazing was somewhat better than usual. In the outlet of a small glen in the southern range (our former northern range) we hit upon a sheet of ice, but so small that it did not yield sufficient water for our caravan; there was no water flowing then from its spring. Descending from the pass, we held on west-south-west and south-west, the valley being wider. On the north it is shut in by a fairly lofty range, flattened and rounded on the top, but turning a very irregular rocky mountain-wall towards the valley. This precipitous face is scored by various steep transverse glens and ravines. Seen from the bottom of the valley it appears to rise vertically, though in cross section it looks, I dare say, something like the accompanying sketch (fig. 128). Along its foot great numbers of kulans were grazing, but we saw no other wild animals.

Fig. 128.

Flat though the threshold was that we had just crossed over, it nevertheless exercised a great influence upon the wind. On the east side of the saddle it was warm, almost burning hot, and there was virtually no wind at all; but the moment we stepped upon the threshold we were met by the full force of the wind from the west, and it brought with it all its attendant discomforts of chilling cold, which rendered mapping a matter of difficulty.

It was evident we were about to experience a change in the orographical arrangement, for a mountain-range now rose at the end of the latitudinal valley we were travelling along. The range which we had hitherto had on our left grew at length quite low, and finally terminated at a broad mountain »gateway» between projecting bluffs; there our latitudinal valley was joined by another coming from the north-west, and then the two, thus united, break through into the big open latitudinal valley on the south. Thus it turned out, that, if we had kept along the southern latitudinal valley, instead of climbing over the first little pass, we should have reached the locality in which we made Camp CXXVII certainly by an easier way, and also by a somewhat shorter way. The reason why the Tibetans took us out of this more southerly road was their inveterate reluctance to let us approach too near to human dwellings. It appeared to be their interest to lead us as far as possible through uninhabited regions, and this was no doubt in accordance with the orders which they had received from the authorities at Lhasa. The intention was clearly to leave upon the minds of the strangers as unfavourable an impression of the country as possible.

The angle between the two latitudinal valleys is dominated by an immense bluff. At its southern base we ascended a terrace or escarpment 4 to 5 m. high, and then found ourselves in a watercourse, down which a stream was flowing, with about 1 1/2 cub. m. of water in the second, breaking against the thick sheets of ice

and rippling amongst the gravel. This stream traverses the new latitudinal valley that comes from the north-west, and is nourished by springs at no specially great distance. It pierces the southern range by the broad rocky gateway which I have just mentioned, and after picking up from the left the dry main watercourse that issues out of the latitudinal valley we had last travelled in, flows towards the S. 62° E., though afterwards it seems to trend towards the south-east, and finally issues upon the southern latitudinal valley. In the middle of this last we observed the white reflection of a big expanse of clay, clearly a dried up lake, though it is possible that the river eventually enters a salt lake, which could not be seen from the locality in which we then were. On the left bank of the stream we pitched Camp CXXVII at an altitude of 4,656 m. above the sea. Immediately south of our camp, on the right bank of the river, rose a smaller detached butte. To the south-west we saw, through a gap in the mountains, a small latitudinal valley running north-west to south-east; beyond that a big range; and beyond that again, that is to the south-west of it, I have no doubt

Fig. 129. LOOKING S 50° E FROM CAMP CXXVII.

Fig. 130. LOOKING S 33° W FROM CAMP CXXVII.

Fig. 131. LOOKING NORTH FROM CAMP CXXVIII.

there was another latitudinal valley, running in the same direction. Possibly it would be more correct to regard these side-glens as transverse glens; in any case they appear to open out upon the big depression of the southern latitudinal valley.

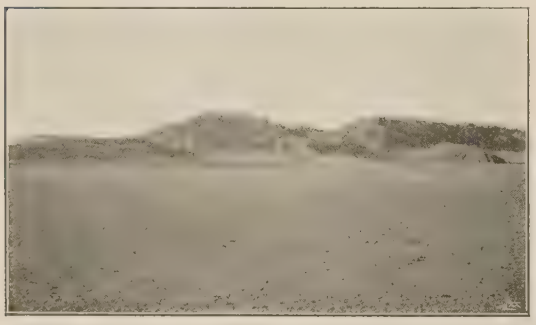


Fig. 132. LOOKING W FROM CAMP CXXVIII.

At this camp there was scarce a trace of grazing, beyond an occasional scrubby plant on this or the other slope. The rock in this region was the same as hitherto, limestone; at the beginning of the day's march it dipped 47° towards the S. 31° E.

In this part of Tibet it is an unusual sound to hear the ripple of water, so that even the small quantity which the Raga-tsangpo was then carrying produced the impression of an actual river, although in the peripheral mountain regions it would simply be called a very insignificant brook. But in this respect this region itself will present quite a different appearance in the summer, for then the entire surface may be as wet as a sponge and large areas of the latitudinal valleys will be more like marshes. It was however a disagreeable region, and bitterly cold, because of a raw icy current of air which flowed uninterruptedly down the valley.

On 14th November we travelled up the Raga-tsangpo, keeping between its bank and the left-hand erosion terrace, this a witness to far more imposing floods during the wet season of the year. There is a similar terrace on the right side of the river; the distance between the two being probably a couple of hundred meters. Down the middle of this space the little stream winds backwards and forwards from terrace to terrace. The hills ascend gradually from the edge of the escarpment or terrace to the mountain-range behind, which appears to form a tolerably definite and independent system. The bottom of the valley rises slowly; it is very rarely that there are any small cataracts. In spite of the constant and copious watering they were receiving, the banks were almost barren.

Then turning our backs upon the river, and taking with us a couple of sacks of ice, we travelled towards the north-north-west and north, making for the outlet of a transverse glen. The big latitudinal valley stretches on the contrary towards the N. 72° W.; here too the usual parallelism still holds. On both sides, but more especially on the south, the latitudinal valley is fenced in by lofty mountain-ranges. At the foot of that on the south we perceived a couple of tents and herds of yaks, at the distance of about 8 to 10 km. Kulans were quite common in this region. At Camp CXXVIII, at an altitude of 4843 m., the grazing was wretched. The cold was keen, but the west wind blew not quite so hard as usual. indeed at times it was quite calm. In the transverse glen, from the afternoon onwards and all the night, there was a wind from the north.

Fig. 133. CAMP CXXVIII.

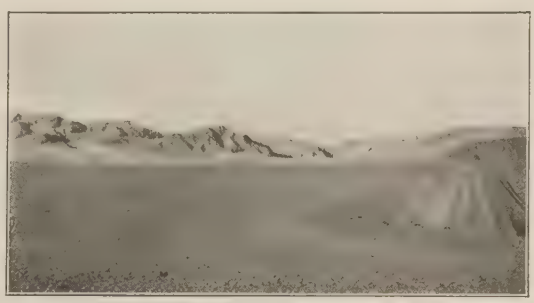


Fig. 134. CAMP CXXVIII.

November 17th. We pushed on farther up the gently rising glen, which grew increasingly narrower as we proceeded, and was inclosed between rocks that exhibited yellow tints. From the east it is joined by three important side-glens, two of them passing one on each side of a peculiar table-shaped bluff, with a flat top, but virtually vertical sides. The glen still continued to contract; the bordering cliffs are not particularly high, but are rugged, wild, and denticulated. Its bottom is narrow and filled with sharp-edged gravel; though there is a belt of soft ground at intervals, as well as moss and a little grass on the ridges and elevations, making the ground uneven. At first the *thalweg* was energetically modelled, but afterwards it grew more shallow. Seen in profile, this glen not seldom presents the appearance shown in fig. 135. The view up the watercourse of this »corridor» *thalweg* is peculiar, and the perspective picturesque. The bare, rugged cliffs on both sides ap-

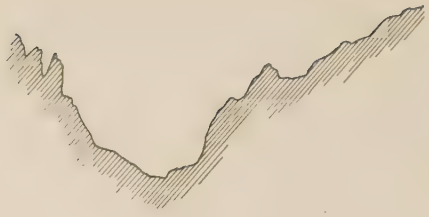


Fig. 135.

pear to be crowned with towers and walls. On the left side of the glen there is a small spring, the water of which was then frozen into stalactites, so that it was like a congealed cascade. Higher up in the bed of the watercourse there were occasional small fragments of ice, showing how the running brook had dwindled away. Still higher up, in an expansion of the glen, there was a little frozen pool, and there the ice was continuous; in fact the ground there was quite marshy, though just then as hard as stone. The grazing was exceedingly scanty, mostly moss; but the grass was by this so dry and frozen that it crumbled to pieces at a touch, like withered fir-needles. This locality is evidently visited by nomads, for we came across traces of a fire and any quantity of yak-dung. Kulans were numerous. At length we reached a convenient threshold pass at an altitude of 5137 m. On its south side the glen expands into a small level area, containing another marsh. To the N. 50° W. we perceived the end of another glen; probably it curves round and

Fig. 136. NEAR CAMP CXXIX.

debouches upon the same latitudinal valley as that which we had recently followed. The mountains in that direction are called Tsegh. Leaving that locality on our left, we kept to the glen that runs down from the pass towards the north-east, but finally turns north and north-west. After that a relatively open, but greatly undulating country disclosed itself on the right, with wild, fantastic, abrupt crests and pointed peaks sticking up above its undulations. On the left, quite close to the main watercourse of the valley, rises a similar bluff, with a grotto and a stone wall at its foot. We made Camp CXXIX (alt. 5038 m.) a short distance beyond the point where the valley inclines towards the north-west. There we found a tiny spring in

MOUNTAIN MASSES NEAR CAMP CXXIX.

the bed of the stream, but the grazing was miserable. There were hundreds of *kökmeks*, and we saw two or three wolves.

At the entrance to the narrow glen the rock was limestone, dipping 73° towards the S. 68° E. At the beginning of the ice-sheet the same rock lay at 24° to the N. 40° W., the strata being very distinct in flakes and tabular masses. The little peak near our camp consisted of dark crystalline limestone, though also of a porphyritic rock, dark, and clearly belonging to a vein the continuation of which could be traced in darker bands to the south-south-west and north-north-east. The greater part of the gravel with which the watercourses of this region are filled consists of crystalline limestone. The rocky ridges stretch from north-west to south-east, or from west-north-west to east-south-east, and are elongated and thrust upwards, as if pressure had been applied at their sides. When seen from the south, they resemble long drawn-out ridges, but when you observe them from the west-north-west or east-south-east, they have the appearance of solitary snags or pinnacles rising above the underlying clay foundation. The accompanying photograph (fig. 136) gives an illustration of them. This particular elevation, when looked at towards the S. 64° E., has the appearance of a pinnacle with vertical sides.

November 18th. After a still night and 24° (C.) of frost the wind got up; then it stopped for an hour or two, but at noon set in again. It came from the north-west. Quite unusually, the sky was half covered with white clouds, which were massed more thickly around the snowy peaks on both sides of our valley; in fact in one or two places they actually appeared to be discharging snow.

From Camp CXXIX, in the district called Barik-mar-tavo, we travelled towards the north-west, making for the outlet of a big glen, formed of two main branches, one coming from the south-west, the other from the south. At the head of both these were vast mountain-masses. After the union of all these glens, the principal glen, deep but narrow, runs towards the north and north-north-east. Its bed is gravelly, and has deep erosion terraces on both sides, that on the right being frequently divided into several steps or platforms. The western promontory of the range that rises north of Camp CXXIX is sharply and energetically outlined, and the range itself is shaped like the little ridges that I have mentioned, its crest being as it were forced upwards by pressure at the sides. The same outlines characterise also the range on the south. At the foot of one of these we observed traces of an encampment. Between the mountains on that side are several small glens, all opening out upon the main glen. Towards the S. 78° E. we commanded an extensive view across a bigger glen, backed by high mountains, particularly on the south, and debouching upon the main glen north of the point of union already alluded to. It runs in part parallel to the latitudinal valley which we had hitherto followed. Generally the scenery is picturesque and attractive because of its bold outlines and the magnificent scale of its architecture.

The united glen, which is a transverse glen, is quite short, and soon trends away again towards the north-west, and finally debouches upon open country. On the right, that is on the north, there rises a vast mountainous mass, exhibiting various shades of light red, pink, and yellow; on the left of the outlet of the glen the mountains are lower, though in places still rocky. The united main watercourse

continues along their foot towards the west. Its steep escarpments and not inconsiderable depth show that vast quantities of water do sometimes pour down it. After emerging from the valley, we were able to travel in almost a straight line diagonally across a self-contained basin with a gentle slope. There was no lake in it, but the ground in the middle was white, so that we were once again undoubtedly in the basin of an old extinct lake. As we advanced towards the north-west, so did the country continue to open out more and more. To the S. 88° W. rose an imposing peak ($\mathring{A}_3$), with some snow on it, and beyond that towered up another higher still. From their locality comes a deeply trenched glen, which unites with our brook. In the south-west appeared the extreme western promontory (A_4) of the range nearest to us on the south. In the N. 5° E. was a snowy peak ($\ddot{O}_3$), which remained a long time in sight. Several watercourses issue out of the mountains on the right and enter the main channel, which itself runs down to the former lake; this we passed on the left. The most important watercourse entered what looked like an old bay of the lake. This, which is bordered by terraces, stretches towards the S. 68° W. into the lowest part of the depression. This locality is called Gamschung; the bluff crowned by A_4 is called Barik-marlak, a mountainous region to the south-east Hurmi-tsava, and the mountain $\ddot{O}_3$ Arupdol.

Fig. 137. CAMP CXXIX.

Fig. 138. LOOKING N 60° W FROM CAMP CXXIX.

The ground was hard and covered with fine, thick gravel, but seldom any grass. Farther on we came across dead and shrivelled japkak scrub, which provided us with first-rate fuel. After that the ground was again bare, and consisted of grey-blue clay, undulating and furrowed by an endless number of eroded watercourses. At intervals there occurred small terraces, which by their positions and directions betrayed that they belonged to the lake. Very probably the belt of japkak once owed its origin to the waters of the lake, the plants having died out since the moisture retreated and left them. At the time of our visit not a single bush was alive. If my assumption is correct, the process of desiccation must have proceeded very rapidly. Yet there is always this possibility left, that the water which gave life to the japkak bushes came directly from the mountains, though in that case we should expect to find at any rate some plants still alive. In the N. 70° E. we beheld a fresh latitudinal valley of considerable size, and at the head of it, in N. 80° E., was a flat snow-capped mountain, much bigger than the one I have just mentioned, for it overtops every

other eminence in the neighbourhood. In the lowest part of the depression the old lake appeared to have extended towards the S. 68° W. There were here large numbers of kulans.

In the lowest part of the hollow the clay was leveller; the altitude reached 4824 m. In its north-western part the ascent is a good deal more appreciable, though no old beach-lines were observable on the slope. On our right, that is to the north, we passed quite close at hand an isolated butte the southern face of which is very steep. A vast number of watercourses run down at an acute angle towards a main watercourse, which proceeds N. 85° E. towards the centre of the depression. We now had big mountain swellings on both the north and the south of us, with a great many rocky spurs and offshoots branching off from them. Bushes were growing in those glens of the southern mountains that are protected against the western wind. We forded the main stream at the point where it picks up several torrents from the adjacent mountains. One of these comes from the N. 31° E., from the locality in which the peak $\ddot{O}_3$ was visible. At the point of junction there was a small detached sheet of ice, the last surviving relic of some river. The entire region was so arid, that even so small a fragment of ice was looked upon as something quite exceptional. As usual we filled our sacks with ice. After ascending for another hour, we reached a flat threshold pass at an altitude of 5062 m. The ground in its vicinity is almost level, especially on the west side, where no slope is perceptible. Camp CXXX, where the boiling-point thermometer gave an altitude of 5060 m., was situated only a few hundred meters from the threshold, at the foot of the southern mountains. The latitudinal valley — the one containing the depression which I have just described — is at this point appreciably narrower. There was no water and the grazing was miserable. This district is called Jam-garavo.

At the first elbow that we passed at the beginning of the day's march dense, grey limestone cropped out at an angle of 23° towards the N. 73° E., the dip being very distinct. All the circumjacent mountains are streaked as it were with bands lying conformably with this; in fact this is the prevailing rock of that region.

After — 26.5° of frost we continued on the 19th November towards the west-north-west and west, the wind blowing from the latter quarter; in that direction the surface also sloped at first. Through the outlet of a large glen on the south we caught sight of a chaos of mountains and glens. It soon turned out that we were only descending into yet another little self-contained drainage-basin in the bottom of the latitudinal valley. It was paved with an expanse of perfectly level clay, then dry; though during the rainy season a little lake is formed in a hollow between two passes. The country round about is marshy, although then frozen as hard as a stone. Some springs, which also were frozen, had given rise to a couple of ice-sheets. The western pass was quite close at hand; its altitude was 5018 m. Thence the slope was more pronounced, though still very gradual. The main watercourse from this pass hugs the foot of the southern range and runs down to a level plain; the flank of the northern range is long and relatively gentle. On our right we passed a small free-standing red butte, with one of the usual sheepfolds constructed of stone on its eastern side. This little plain forms an exceedingly flat gathering-basin, in which all the brooks concentrate into one; this pierces the northern range, though

afterwards it no doubt trends towards the west. On the south rises an imposing range, in part capped with snow. Here the altitude reached 4944 m. The ground is strewn with gravel, but when we began to climb up to the next pass it became soft, with a slight sprinkling of grass. The acclivity was gentle, though quite noticeable. On our right, that is to the north, we had a range that exhibited the usual wild and broken outlines; and beyond it ran a latitudinal valley parallel to that which we were following. The pass is flat, reaches an altitude of 5032 m., and is distinguished by an obo with fluttering rags. Only a few minutes farther towards the south-

Fig. 139. LOOKING S 65° E FROM CAMP CXXXI.

south-east we had to climb over yet another threshold pass at about the same altitude. Between these two passes lies a small *Mulde*, with glens sweeping down to it from the crest of the range on the south. After uniting into one, they break through the northern range, making for the north-west, and running close past a smaller level clay expanse, which is separated from the transverse glen by a very flat and insignificant threshold. The latter looked as if it would have afforded us a nearer and more convenient road; but instead of striking into it, our guides led us up to the second threshold pass. From its summit we had a magnificent view across a wild mountainous country to the south, where however two immense ranges, fantastic and serrated, could readily be distinguished. Of these the nearer one is pierced by a big »glen gateway»; while the outlines of the remoter range are more rounded, though it is also higher and carries more snow on its summit. Between us and these ranges there is a big latitudinal valley, sloping down towards the

LOOKING S. E. FROM CAMP CXXIX.

north and north-west. Upon it debouches the recently mentioned transverse glen from the two little passes. By the side of this glen rise a couple of buttes almost or quite isolated. We were now south of the country of Rundor, which Deasy visited and mapped. There he notes a very extensive »Sandy Plain», called Tai Chaka. He has drawn as meridional the valleys which come from the direction of Rudok, that is from the south, and open out upon this depression. This is for that region a rare thing, for all the other valleys in that quarter run from south-east to north-west. As however he did not personally see the country to the south of his »Sandy Plain», he has indicated the direction of these valleys by dotted lines; and he even makes the one farthest west proceed towards the north-east. It is difficult to determine how far this conception is correct or not. On Nain Singh's map the direction is very decidedly from south-east to north-west. The particular valley into which we had now entered does, it is true, run almost north, and thus is in agreement with the direction attributed to the valleys of this country by Deasy; but we found that it afterwards bends round to the north-west and west.

Fig. 140. LOOKING SOUTH FROM CAMP CXXXI.

Fig. 141. LOOKING SW FROM CAMP CXXXI.

From the last pass we travelled towards the north-west and west, across a surface that slopes gradually down towards the new latitudinal valley, and we soon realised that there was no fear of our getting lost amongst that labyrinth of mountains, which had at first appeared so formidable. It is remarkable how persistently these great ranges of mountains had accompanied us on the left or south all the way from Naktsong-tso, not only with inflexible tenacity denying us access to the forbidden parts of Tibet, but also jealously cutting off our view of them. They form, as it were, a family of mountains, a mountain-system, which without any noteworthy breaches stretches all the long way towards the west-north-west and north-west, and consists of a number of parallel subordinate ranges, with a main

Fig. 142. LOOKING N 65° E FROM CAMP CXXXI.

range in the middle, this being not seldom capped with snow. Here again it is fair to assume that this mountain-system constitutes the dividing-line between the self-contained drainage-basins of the central plateau and the regions south and south-west of them, which drain into the ocean — the sources and head-streams of the Indus lying towards the west and those of the Brahmaputra or Tsangpo towards the east. The region is however too little known for it to be possible to generalise regarding it with anything like certainty. There still remains a wide interval between on the one hand the region that has been visited by Nain Singh, Littledale, Deasy, and myself and on the other hand those more southern parts of the Tibetan plateau which have been visited by several English travellers, Strachey and others, of whom the last are Ryder and Rawling. It is possible that the mountain-system in question does not form a sharply demarcated boundary, but it may also perhaps embrace a succession of basins with lakes more or less self-contained. All the same it seems to me that the mountain-system is most probably a true dividing-line between the self-contained drainage-area and the southern peripheral area. Anyway these mountains served continually as an immovable hindrance to our view towards the south; on the other hand we were able on several occasions to cast a glance across the highland region to the north through gaps in the mountainous barrier. One thing is at all events certain, that a vast upswelling of the earth's crust separates those parts of Tibet which we traversed from the region of the Indus and the Tsangpo.

We made our way down from the second pass by a shallow transverse glen, passing close on our right hand some minor bluffs with a reddish tinge, at the foot of which were one or two of the usual circular stone walls, pointing to a permanent encampment. During the past few days we had seen several such sheepfolds; thus it is pretty clear that this region is visited in summer by not a few nomads, though in winter they proceed farther south with their flocks and herds. This brought us out into the big latitudinal valley, with two buttes in its middle, one small, the other of medium size, and both detached. On the south are wild mountains gapped by transverse glens running towards the north. The surface is hard and level, and we crossed over several dry watercourses. In one of these, in which were some small withered bushes, we pitched Camp CXXXI, at an altitude of 4845 m. There was no water, but we fetched ice from the foot of the great range which towers up in the south at the distance of a couple of kilometers, and culminates in lofty peaks to the S. 12° E. and S. 12° W.

During this stage the rock consisted almost everywhere of the usual limestone, dipping at several different angles. In an isolated hill near Camp CXXXI we came across black clay-slate, dipping 8° towards the S. 12° E.

CHAPTER XVII.

DESCENDING FROM THE HIGH PLATEAU.

November 20th. To reach Camp CXXXII we had to march 21 km. towards the N. 72° W. across an easy country with a gentle slope. The wind was not strong, but bitterly cold, and after 1 p.m. the sky was almost entirely covered with clouds, especially in the west, where they were massed together and looked as if they might easily contain snow, yet none fell. As a general rule, snow does fall at that season, but according to the Tibetans, that winter was somewhat of an exception. The absence of the sun in no way intensified the cold, rather the contrary: for the sun is perfectly powerless against the wind.

After striking camp, we proceeded first towards the north, down the bush-grown watercourse, though the vegetation soon died away. After that we doubled the eastern extremity of the moderate-sized butte and swung away towards the north-west. A larger watercourse runs in the same direction, and upon it all the others in the locality converge. On the left we passed a broad glen, which comes out immediately west of the detached bluff, its water-channel skirting the western side. Up through this glen we obtained an instructive view as far as the main chain of the southern snowy range, with its many spurs and offshoots, and many glens ensconced between them. There was no great quantity of snow, in some places only streaks and patches in the more sheltered localities: in the morning, before the sky became clouded, these glistened like wet white colours. The range which we then had on our right is quite imposing; and the transverse glens which come out of it terminate in radiating screes. The nearest range on the left is quite insignificant; close along its base runs the watercourse that, issuing out of the southern side-glen, constitutes the principal drainage artery of the latitudinal valley, for it picks up and absorbes the channel of the latitudinal valley which we crossed over just north of the detached mountain. It is also joined by several watercourses from the mountains on the north. This main channel we followed towards the north-west and west-north-west. The valley thereupon contracts a little, and the watercourse crosses it diagonally; the northern range grows lower and lower, and finally terminates in a rocky promontory. On the north of it opens a fresh important latitudinal valley, which effects a junction with that in which we

were travelling. On the other hand the southern range grows higher, and the outlets of its side-glens are choked with extensive gravelly screes, down which their drainage-arteries radiate fan-wise. Between that particular range and the main range of the system intervenes a valley, parallel to the one which we were then in. The surface slopes gradually down towards a little flat expanse of sediment, which would appear to be at times overflowed with water from the main channel. It is a species of miniature marginal lake, dammed up by the detached butte that rises in the middle of the latitudinal valley. This elevation is elongated, and strangely

Fig. 143. LOOKING N 6° E FROM CAMP CXXXII.

enough elongated meridionally; at its eastern foot, that is on the leeward side, sand-dunes have been built up. After doubling the northern shoulder of this butte, the main watercourse makes a bend to the south. Immediately east of it is another similar miniature mountain, but it stretches from east to west. Strictly speaking both these belong to one and the same ridge, which has been sawn through by the watercourse, the breach by which it effects its passage being cut 2 to 3 m. deep through the gravel-and-shingle. In the middle of its bed small thresholds and bands of conglomerate crop out here and there. Instead of keeping to the watercourse we proceeded round by the north of the second butte, and after that travelled west-south-west across hard gently sloping ground, thinly sprinkled with gravel, and except for a blade or two of grass occasionally, it was almost barren. On our right we passed a free-standing butte, close at the base of the range on the north.

LOOKING NORTH FROM CAMP CXXIX.

This still continued to be of noteworthy dimensions and to possess gravelly screes in the outlets of its glens, the watercourses radiating over them as before. One or two of them appear to be able to get down to the middle of the latitudinal valley, for we crossed over them; they are however but faintly defined and seldom carry water. The biggest was of course the main watercourse which we had formerly crossed over a couple of times and which so unexpectedly pierces the little ridge in the middle of the valley, instead of flowing to the north or to the south of it. The main range on the south, which still continued to be snow-clad, had now receded to a greater distance; E4 is one of its loftiest peaks. West of that summit the range is less accentuated and less wild, except for the denticulations and rocky pinnacles rising above its crest; bu its flanks are softly rounded. Farther east the rocky needles soar up from it everywhere.

Fig. 144. NE OF CAMP CXXXII.

Fig. 145. LOOKING S 53° W FROM CAMP CXXXII.

The surface next slopes down to a fresh self-contained depression of the same character as the preceding. Its pyramidal deposits of white gypsum filled the foreground, but we did not see any lake. Nor, strange to say, was there any trace of terraces or old beach-lines on the slopes, and yet these lie exposed to the west. The cause of their absence is no doubt the very gentle character of the slope, where owing to the flatness any beach-lines that may have existed would be the more easily planed away. At the very bottom, however, that is at the eastern edge of the depression, there is a terrace barely two meters high, and close under its foot is a shallow pool, then covered with ice. This was the first place at which our caravan animals were able to drink their fill after a long compulsory fast. Here there were springs, and we soon ascertained, that the ice-sheet wound away westwards like a river between the gypsum platforms. This is all that is left of the old lake. In the extreme east of the depression, where a little grass was growing on loose ground, we pitched Camp CXXXII at an altitude of 4,596 m. The altitude at the little ridge in the middle of the valley was 4,674 m. The rock at the same locality was the usual species of dark limestone, dipping 23° towards the S. 15° W., but it was darker and harder than usual.

November 21st. During the night the temperature dropped to — 28.2°, this being the lowest we had hitherto recorded during the winter. It was a glorious morning, the air being quite motionless, though the frost was keen and the colouring wintry. Before we started, we let the animals drink as much as they liked, for in

these regions we could not count upon finding water every day; indeed it would be almost perilous to travel through these high desert regions without a guide.

Almost the whole of the stage, 28 km. towards the N. 83° W., was across the bottom of an old lake, of which nothing now survives except the gypsum deposits. Sometimes the surface is perfectly level and vividly white; sometimes it is shaped into tabular masses and terraces, 4 to 5 m. high at the most; sometimes, again, these irregularities are very much lower, and locally are interrupted by hard, yellow, muddy clay, which had recently been under water, in part as level as a floor, in part furrowed by brooks and rivulets; and sometimes the surface was schor-like, slightly moist or cracked. Occasionally, though it was not very often, we would pass a little patch of yellow grass, the blades few and far between. The unusual feature about this gypsum formation was however that it was in places quite full of the white shells of the same little molluscs that we had also observed beside the Naktsong-tso. Here however they were extraordinarily common, sometimes as thick as in the Desert of Lop. Farther on the ground consisted of fine, dry powdery dust, with a thin scattering of small gravel, though only on the surface, where it lay as if swimming in water. One or two decimeters below the sur-

Fig. 146.

face there was no gravel; nevertheless what lay on the top was sufficient to impart a darker grey tint to the ground. The kulan paths and the tracks of single kulans, like the trail of our caravan, showed up therefore as lighter-coloured lines and dots against the darker background, for the gravel was there covered over with the disturbed dust. The frozen pools in the middle of the depression still continued to resemble a winding river-bed as we followed them towards the north-west. The Tibetans declared, that they were neither springs nor river, nor lake, but a *luma*, or what the Mongols call a *namaga*, or »open pool». These accumulations of water do of course originate from springs, which gush out in the lowest trough of the depression and collect in those parts of the former lake that are deepest. The water was perfectly fresh, nothwithstanding that it lay over barren ground in a self-contained drainage-area; the ice was thick. The largest sheets of water were situated at the point in our route where we changed our direction from north-west to west. The pool was however only a couple of hundred meters long and barely 100 m. broad. The ice that covered it was the purest and most beautiful blue imaginable, nor is that in any way surprising, seeing that the water is perfectly still and limpid, the immediate surroundings a vivid white, and the sky as reflected on the ice a turquoise blue. Generally these long, narrow accumulations of water are framed about with fairly steep terraces, like the scarped terraces of a river-bed. The last pool too, which had not the slightest indication of a marsh round it, possessed fresh water. From this we may conclude, that this water is at times in motion. Farther east, at Camp CXXXII, it emerges into the light of day

and then trickles slowly westwards towards the big basin, which no doubt possesses an underground emissary. Thus the water is renewed with extreme slowness, though still fast enough not to acquire even so much as the slightest flavour of salt.

After that we left all the gypsum expanse to the south, travelling across hard gravelly *saj*, which slopes down gradually from the foot of the moderately high, rocky range, that ran quite close to us on the north. The opposite range on the south is bigger, and was then streaked with snow. The lake was once narrow, of the same type as the Luma-ring-tso. On its northern side it has only a single strand-terrace, two or three meters above the lowest part of the depression, distinctly though not sharply outlined, and with a gentle fall. It looks as if it were so long since the lake dried up that all its older, higher strand-terraces have been planed away. But that is so in appearance only; as we shall soon see, there exists another explanation of the absence of strand-terraces here. Although this lake may be said to be akin to the Luma-ring-tso and the Tsolla-ring-tso, it has reached a more advanced stage of desiccation than they have. In their case portions of the former

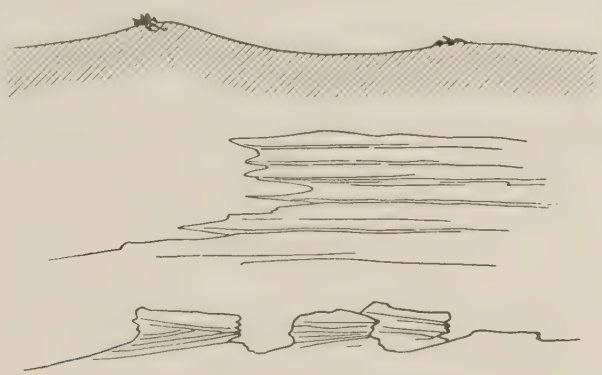


Fig. 147. GYPSUM ELEVATIONS.

lake still survive, their area varying according to the season; but in this new depression there is no part of the old lake left, for the pools which we observed are fed continuously by springs. In order to understand why no strand-terraces have been able to form around this old lake above a certain height, we have only to call to mind two or three hypsometrical data, which, although not *per se* absolutely trustworthy, are nevertheless in agreement with the conclusions suggested by a study of the conformation of the ground, that is to say of the eroded watercourses. We found that the old lake depression lies at an altitude of 4,573 m.; Camp CXXXIII, farther on in the same latitudinal valley, had an altitude of 4,597 m.; and a spot quite close to Camp CXXXIV an altitude of 4,549 m.; though after that the surface slopes steadily down to the Tso-ngombo. Thus Camp CXXXIII will have stood very nearly on a swelling that serves as a water-divide in the latitudinal valley, but the divide rises so little above the existing level of the lake that any idea of the existence of old strand-terraces is absolutely precluded. In other words the depression belongs now to quite a different category of lake depression from, say, the Lakor-tso. That is to say it cannot have been deep; it was a lake

drained by an emissary. It sent out a river, which flowed down to the Tso-ngombo and the Panggong-tso, and, as we shall see later on, won an outlet to the Indian Ocean. As a consequence of the diminished precipitation the Panggong-tso has been cut off from the Indus system and the same cause has severed the connection

Fig. 148. GYPSUM ELEVATIONS.

between this new lake and the Panggong-tso. The clearest proof that this was a freshwater lake is the mollusc shells. The remains of vegetation preserved in the dried ridges suggest that Algæ and seaweed also existed in this lake. These little ridges or ribbings (upper ill. of fig. 147) form meandering black lines on the white

Photo. A. B. Lagrelius & Westphal.

MOUNTAINS SOUTH OF CAMP CXXXIII.

ground, sometimes at a considerable distance apart, sometimes with intervals of only one or two meters. They evidently indicate old beach-lines of the disappearing lake. In some places a species of strand-terrace can also be observed, pointing to the same conclusion as the beach-lines, but indicating a more permanent stage in the lake's shrinkage. The gypsum deposit at the bottom of the lake is almost entirely exposed, and is not overlain by any other deposits or by any material washed down off the adjacent mountains. It such material is at times carried down by the rivers after rain, it does not at all events remain; but during the next ensuing dry season it is blown away again, and in this way the gypsum deposit always remains exposed.

Fig. 149. GYPSUM ELEVATIONS.

The bedding of the gypsum is exceptionally distinct, though not always horizontal. The irregular slope can be especially studied in the small free-standing tabular elevations; as a rule the departure from horizontality is very slight, but sometimes it amounts to 10° to 20°, and the inclination is now in one direction, now in another. This is of course wholly a secondary phenomenon; it has been produced either by a slip of the next underlying bed, a space having been hollowed out underneath by the excavating agency of water, or by erosion at the base of the particular local elevation. The sides of these free-standing elevations afford an excellent opportunity for observing how the different beds of gypsum vary in hardness. Some form indentations or notches, others projecting ledges. Owing to the regularity of their shape and their inflexible parallelism they frequently give the impression almost of having been modelled by human hands. Generally several of these tabular elevations stand in a group together, being separated by furrows or passage-ways more or less broad. Originally this mass of gypsum, which has in the course of time become deposited on the bottom of the lake, was perfectly

horizontal; but since it has been exposed to wind and weather it has fallen an easy prey to their machinations. A slight irregularity at one point has given rise to a grooving, and down this a rainwater torrent has made its way in the rainy season, while during the dry season the gully has been excavated deeper and deeper by the wind. The reason that they have not been cut down to a greater depth than what they now possess — they are seldom more than two meters deep — is of course this, that the surface of the tabular elevations and platforms themselves are in their turn exposed to the filing and planing actions of the wind. One difference is noticeable between the gypsum formations in the lake depression and those which we studied on the shores of the Lakor-tso. In the case of the latter they are softer and more rounded, but here harder and mostly with vertical sides. A strange, an extraordinary landscape, — deathly white, flashing in the sunshine! It is however the same phenomenon as that which we encountered in the Desert of Lop, the principal difference being the diversity of the material.

Fig. 150. THE MOUTH OF THE GORGE SE OF CAMP CXXXIII.

Next we travelled for a space on hard saj, then crossed over an expanse of level sedimentary clay, and then once more entered a gypsum region, its elevations rising on both sides of us. At last however the old lake bottom came to an end, tapering away to a point in the west, close to the foot of the southern mountains. Beyond that the ground became hard, with a thin sprinkling of fine gravel, and some grass and scrub, though these latter but sparingly. Close to the western margin of

the lake-basin we became aware of a slight rise; that it was a rise was only evident from the dry watercourses converging into a depression. But shortly after that the surface appeared to be perfectly level, without the slightest elevation: not even the faintest undulation was observable. The only really noticeable feature was that the bottom of the latitudinal valley slopes a little from north to south. Its breadth there is about 6 km., and its lowest part is in the south, at the foot of the mountains; and this is also indicated by the bearings of the western end of the lake. The southern range still continued to be energetically developed, though its main chain is for the most part hidden by short wild, rugged spurs, the lower flanks of which are often studded with minor peaks and rocky protuberances. The only glimpses we caught of the main chain were through the outlets of the transverse glens. In those outlets there are, as before, wide-spread gravelly screes; the upper parts of the glens are steep, narrow, and not easily approachable. The range on the north is of moderate dimensions; its spurs are longer and flatter. One or two of these transverse glens appeared to lead up to relatively easy passes, by which one would be able to get over to the next latitudinal valley on the north, which runs parallel to the one in which we were, and probably is identical with it. It was probably through that latitudinal valley that Deasy travelled in his journey through the country of Rundor. Nain Singh's route lay some distance to the south, but we had crossed it only a couple of days before.

During the latter part of the day's march it was impossible to tell in which direction the surface sloped; except for the inclination towards the south, it was as level as a floor. It is possible, that we crossed over the water-divide before we reached Camp CXXXIII, for its position could only be determined with the help of a levelling tube. Otherwise the threshold must be sought for somewhere between Camp CXXXIII and Camp CXXXIV, and not far from the first-named. Strange to say, it would be vain to search for traces of eroded watercourses in the neigbourhood of Camp CXXXIII: there was not one to be seen on the whole of that level expanse. It was not until the following day that we came across any, and then they ran towards the west. If the theory which I have thrown out above is correct, one would reasonably expect to have found traces of the old emissary that drained the lake; but we did not find any. It was only along the base of the southern range that we noticed anything at all like it. There we did observe a well-defined terrace or escarpment, 4 to 5 m. high, and presenting in profile the appearance shown in the annexed cut (fig. 151; also 150). The whole of the lower part of the slope looks as if it had been shorn away. It is not however continuous, but is sometimes interrupted by recently formed gravelly screes. Yet even the bigger screes that block the outlets of the transverse glens have been cut through in a similar manner, proving that the sedimentary matter which has been washed down across the scree since the shearing took place has not been sufficient to cover over and obliterate the old terrace, which was formed at a time when the climate was wetter than it is now. During the succeeding day's march the shearing was even more pronounced. This is, I have no doubt, the last trace of the emissary from the lake, which, as a consequence of the configuration of the ground, crept close in to the southern base of the range, where its erosive activity gave rise to the terrace in question, and at an earlier epoch, when

Fig. 151.

there was a copious inflow into the lake, the erosive energy of its emissary must have been especially energetic. And yet the absence of a watercourse along the bottom of the valley is not surprising, because the rivulets which stream down off the northern mountains towards the mountains on the south are far too feeble to get as far; in fact, they probably disappear shortly after they issue out of their respective transverse glens. During the course of time the volume of the lake's emissary will have grown less and less, until at last it was a mere brook that crawled along the base of the terrace, and now even the brook has ceased to flow. When that came to pass, the lake was cut off and turned salt. In the intermediate transitional stage the lake would oscillate and vary in level from year to year and from season to season. Now it has entirely disappeared, with the exception of the basins at the springs, and these probably expand in area during the rainy season. Here we have an instance of the way in which the plateau-land of Tibet becomes broken up into a continuously increasing number of self-contained drainage-basins in consequence of the progressive desiccation of the climate. On the whole these parts of western Tibet preserve the same accentuated characteristics as those parts of it which we had been travelling through all the way from Naktsong-tso. Its character is best and simplest defined by saying, that it is a stupendous plateau-land, upon which mountain-ranges exhibiting wild craggy outlines have been piled up; these run towards N. 50° to N. 60° W. and are separated one from the other by latitudinal valleys more or less broad. From the route that we travelled there would have been no difficulty in making our way towards the north, for the ranges on that side are often broken and possess many convenient passes. But it would be a much more difficult business to penetrate southwards from the same line of march, because the mountains in that direction are higher. Hence we may still continue to speak appropriately of the immense swelling which divides Central

Fig. 152. LOOKING N 22° W FROM CAMP CXXXIV.

CAMP CXXXIII.

Tibet from the peripheral regions of the Tsangpo and the Indus, which drain to the ocean. The latitudinal valleys are choked with detritus; their floors are in general level, but all the same they are broken up each into a series of self-contained drainage-basins, the greater number of which are at the present time dry, though formerly they contained lakes. Only in a few of them are there fragmentary relics of a lake still remaining. This holds good however only of the particular zone of Western Tibet that I traversed. In the next zone to the north the circumstances are different, as appears from Deasy's journey. In the belt of country that he travelled through he found an abundance of lakes; though towards the south of the region that he explored he found also a great number of dried up lake depressions, that is to say in that part of it which approaches nearest to the region that I explored. I propose to return to this interesting phenomenon in another connection. The orographical arrangement thus outlined, which occurs indeed with unalterable persistency throughout the whole of Tibet, renders a journey such as that which I took not only very monotonous but also less fruitful in geological results. But, as I have already said, the condition of my caravan made it necessary for me to reach Ladak by the shortest possible route.

Fig. 153.

The part of the southern range which overhung Camp CXXXIII rises in somewhat majestic masses of rock, slashed with deep, narrow ravines and transverse glens, short and steep, and its crest was capped with snow. In one of these glens we discovered a frozen spring. The grazing was better than it had been for a long time, a good deal scattered it is true, but still sufficient. Some hard, dry thorny scrub yielded fuel. Thus we were fairly well situated. So far as we were able to judge from the distance, the strata in the northern range appeared to dip towards the north, and those of the southern range towards the south. Hence it was an anticlinal valley we were in.

On the 23rd November we made a short march towards the west, but it was so far forth interesting in that I now secured unambiguous evidence of the fact that the last lake depression did once possess an emissary towards the west, as indeed I had suspected from the presence of freshwater molluscs in its basin. The weather was moreover favourable, the wind of little account, the sky clouded over in the morning, but afterwards bright.

We kept along the base of the southern mountains, which still retained their rugged features, and the transverse glens still continued to terminate in triangular gravelly screes. Through a gap in the northern range we perceived to the N. 30° E. an immense, flat, dome-shaped snowy mass. As we proceeded the terraced shearing along the foot of the southern range became more and more emphatic. It was the former bank of the lake's emissary; but there is no terrace on its right, that is to the north. The slope there is perfectly level, as may be seen from the profile

in fig. 153. The channels made by recently flowing water in the bottom of this river-bed are disproportionately small in relation to the dimensions of the bed itself. The aqueous force which shaped the left-hand terrace has disappeared, and it is only transient brooks which now seek their way down it. The greater part of the bottom is covered with coarse sand, dark in colour, and swept up into low ridges, or rudimentary dunes. In the preceding desiccated lake we also saw something of the same kind.

Fig. 154. ENTRANCE TO A VALLEY IN NORTHERN TIBET.

Fig. 155. LOOKING N 63° W FROM CAMP CXXXIV.

In the north-west, at the foot of the northern range, we perceived three black tents. Doubling a prominent headland of the southern range, we found ourselves in the throat of a considerable latitudinal valley, extending towards the S. 62° E., and thus clearly parallel with the valley which we had travelled along during the last few days. The new valley was of moderate breadth and at its distant end we could make out the faint outline of fresh mountain-ranges. In its lower part it possessed grazing, bushes, and ice-sheets. These last were formed by a river that rises in this valley itself; our Tibetans called it the Tsanger-schar. For some days to come we were to follow it down to the Tso-ngombo. It flows through marshes and swampy ground, which were then frozen so hard that they actually bore our camels. The grazing was unusually good. The altitude of Camp CXXXIV was 4587 m., thus only a couple of meters higher than the bottom of the old lake. But this is to some extent misleading, because shortly after being between 40 and 50 m. lower than the camp we proceeded a little way up a glen-opening. South-west of us was a rather imposing section of the new range on the south, that is the range which rises on the west bank of the Tsanger-schar. In this locality were several nomad encampments, and in one or two places we observed flocks of sheep. It was here that we were joined by a fresh relay of guards, who were to conduct us farther towards the frontier of Ladak.

The town of Rudok was reported to lie three days' journey to the south-west, and except that they would be long days' marches, the statement is in accord with fact. On Nain Singh's map we see only the lowest part of the Tsanger-schar, together with its embouchure in the Tso-ngombo. But he makes the river come from the north-east, and along its course he has entered a »Road to Kiria and Khotan»; this may indeed be the case, but if so, it is a road that is seldom used.

November 25th. In the afternoon the wind blew hard from the west, completely numbing us. The river kept pretty close to the foot of the mountains on the south, leaving however between them a belt of marshy ground overgrown with scrub and grass; in summer this tract will certainly be converted into an impassable quagmire. At this part the river winds very abruptly, a proof of the gentleness of its fall towards the west. The southern range rises in fairly low, but precipitous crags. Along their base gush out a whole series of open springs, which one after the other run into the Tsanger-schar, or Sangar-schar as some of our Tibetans pronounced it. At intervals these rivulets form little basins; in which the usual crustaceans were living, as also molluscs like those in the dead lake, except that these were still alive. Algæ too

Fig. 156. LOOKING N 50° E FROM CAMP CXXXV.

were observed. Fish were especially abundant in the principal stream; in fact upon them we for the most part lived during the whole of the time we travelled beside it, and later whilst travelling alongside the Tso-ngombo. The fish frequent by preference the deep and open parts, more especially the pools formed at the confluences of the bigger spring-fed rivulets, where the water was relatively warm. One of these rivulets was particularly big, and wore a peculiar appearance, in that a strong stream gushed up out of a depression in the level ground, only a couple of meters from the foot of the mountains. Wild-duck also were present. Already we began to note indications that we were approaching what, in comparison with the niggardly, uninhabited, and barren high plateau we had so long been tramping across, might be called a favourable and hospitable country. The ground also slopes down slowly and gradually, a great help to a caravan so exhausted as ours was. Meanwhile, in consequence of this plentiful inflow of rivulets, the Tsanger-schar gradually increased in dimensions. Our Tibetans declared that it has its source not very far above Camp CXXXIV, in a part of its lower latitudinal valley in which similar springs are more

than commonly numerous. And it is indeed probable that in winter, the season it was then, the river is fed by spring-water only, whereas in the rainy season it will swell to a more than usually important stream.

Soon the river leaves the foot of the southern mountains and crosses the bottom of the valley to the mountains on the north, and we kept faithfully to its left bank. But before the relatively warm spring-water had got very far it became so far cooled that the ice-sheets which lined it at the side increased in breadth, until finally the stream, and it was very broad, was frozen right across from one side to the other. In some places the recently arrived spring-water could be seen spreading out over the ice-sheets, and was itself sometimes frozen. In this way the ice increased in both thickness and extent; and the process goes on, I have no doubt, all the winter through, until at last the bottom of the valley becomes literally choked with ice, though there will always certainly be occasional open emissaries by means of which the spring-water flows on farther.

Fig. 157. LOOKING SE FROM CAMP CXXXV.

The range on the south is dominated by several peaks; one of these, a double peak M_4 N_4, was pretty close to us, and bore a sprinkling of snow. On the nearer side of the range rises a smaller detached part of the range, that is to say a free-standing ridge. Several similar foot-hills line the base of the northern range, and between them the glens debouch upon our latitudinal valley. At Camp CXXXV thorny bushes were growing, but the grazing was wretched; perhaps this was because the ice spreads out every year over the bottom of the valley. The absolute altitude reached 4485 m., or 100 m. lower than the preceding camp. We had now therefore left the highest part of the Tibetan plateau behind us, and were to descend gradually, but steadily, towards the west. This district is called Sumdel.

November 26th. In proportion as we advanced westwards the wind seemed to be changing. This day there actually came gentle puffs from the east, and

as the sky remained clear, we felt it at times almost warm, at all events in comparison with the bitter cold which we had experienced on the high plateau. Moreover the day brought with it a welcome change of scene — a picturesque country, favourably sloping ground, and a cheery, prattling stream. Our direction was west-south-west, and the distance we covered was nearly 20 kilometers.

We kept to the left bank of the river. The southern range was now fairly imposing, and distinguished by wild and picturesque crags. At the outlets of the short, steep transverse glens were gravelly screes of the usual character, one or two of which we crossed over. They are seamed by a number of watercourses, often rather deeply incised. These screes consist of moderately coarse gravel, all the finer material having been washed away out of it. One of them forms a regular rounded bluff, and forces the river to make a bend to the north. From the top of it we descended pretty steeply to the outlet of a fresh transverse glen, which is in so far different from its neighbours that it forms a hollow between deeply undermined erosion terraces. Below this point came, in a little expansion, an almost level flat, covered with grass which had not been touched. In the middle of it was a pool, surrounded by a marsh, and the ground was rough, there being a number of small mounds with scrub growing on them. This ground is overflowed by the river in the wet season; and the pools which I have mentioned, then hard frozen, were the last surviving relics of such an inundation. Here again the gentleness of the fall is witnessed to by the sharp bends that the river makes. On the north side of the valley, between the river and the main range, rises a small mountain butte. Just below the marsh two larger transverse glens emerge, uniting just as they issue from the mountains.

The valley continued to contract; in fact below the marsh it might fairly be described as narrow. At the same time the slope grew steeper. The river, which had hitherto been divided into several arms, now gathered itself into one channel, and its windings became very insignificant; for long distances the course was almost perfectly straight, the water rippled along in a lively fashion, and the fringes of ice continued to grow narrower. Occasionally, where the fall again became gentler, the river was for some distance entirely covered with ice. Fish abounded in it everywhere, and wild-duck occurred every now and again. The transverse glens in the southern mountains became increasingly wilder and more inaccessible. Their outlet frequently resembles a dark gateway flanked by vertical walls of rock. It was only through these occasional breaches that we obtained glimpses of the main chain, slightly sprinkled with snow. Its peaks are jagged and capricious in outline. In its narrowest parts the bottom of the valley was entirely filled with sheets of ice, pure and bright, and sparkling like silver in the sunshine. The river was at this part divided into several open branches, boiling amongst the ice-sheets. On a patch of free soil between two of these branches some bushes were growing.

Shortly after this our valley was joined by an exceptionally big side-glen coming from the south-west and offering a free view of the main range in that direction. It terminates in an especially big gravelly scree, furrowed by several large rainwater channels. In its lower part it is joined by smaller glens, with bushes growing in their sheltered outlets. From that point the principal valley runs towards the west-north-west, and kept it that direction all the way to our next camp.

At a spot above the belt of ice, where the river was frozen deeply, we had already crossed over it, and were now travelling along the gravelly scree on its right or northern bank, the edge of which, having been washed away by the stream, forms a vertical escarpment or terrace, frequently pierced however by deep fissures. The river is then, for a space for the most part open and winds through water-logged ground. On the south side of the glen stands a big bluff. Thereupon the river becomes lost in a broad expansion resembling a glacier lake, which fills practically the whole of the bottom of the valley except for a narrow strip on the north side, the only ground free of ice to travel on. The northern range is wild and craggy, and sometimes it was as much as ever we could do to get round its outjutting promontories without coming into contact with the ice. The slope there was quite insignificant. A little higher up in the valley we had passed a similar level expansion, its bottom being covered with clay, without any ice. Into it the water sometimes gathers, and it now looks like a little filled-up lake. At the western end of the glacier lake the river issues again in a collected channel. The banks are

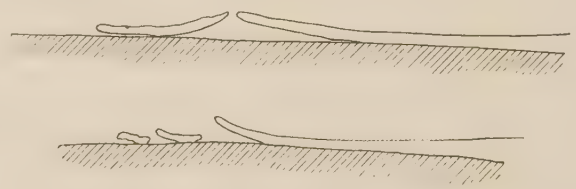


Fig. 158.

there so low that they were almost *au niveau* with the surface of the stream, and would certainly be overflowed when the latter reached a higher level. Bushes were growing beside the river at that place. The absolute altitude was 4407 m. (Camp. CXXXVI), or a descent of barely 80 m. from the preceding camp. On the north an especially big glen opens out, being composed of two subsidiary glens which unite higher up. Its great gravelly scree, with its furrowing watercourses, reaches all the way down to the river at Camp CXXXVI, and it is on the edge of this scree that bushes grow, whereas grass is conspicuous by its absence. The river at this part was not more than 50 to 60 cm. deep, its water bright and beautiful, and it rippled along without breaking into cascades, and emerged from underneath the extreme point of the ice-sheet. The latter was crackling and snapping all night long. Its edges were as a rule slightly turned up, and in some places it was crossed by ridges, in the way shown on the accompanying illustration (fig. 158).

Even in this short stage it was possible to observe a distinct change in the character of the scenery. True, we had on many occasions previously made our way through narrow glens between vast mountain-ranges, but those glens had for the most part maintained themselves at a uniform level of altitude and consisted of a series of self-contained drainage-basins. Here on the contrary, we had reached a region in which the slope is constant, a narrow valley in which erosion has an opportunity to develop its energy more actively. In the preceding glens the products of denudation have been washed down by the temporary streams to their lowest parts,

and there they remain, helping to fill up the inequalities of the surface. In the valley of the Tsanger-schar erosion is not only excavating its bed increasingly deeper, but the solid material which is washed down from the sides into the bottom is also being gradually carried off as well. The landscape as a whole is distinguished by bolder relief, a relief more accentuated on the vertical scale. In a word, the superficial forms are more peripheral, whereas hitherto they had been predominantly central and plateau-like. Anyway we had now reached the transitional region between these two types of landscape. In point of fact however we may safely

Fig. 159. THE TSANGER-SCHAR NEAR CAMP CXXXVI.

say that ever since we started from the vicinity of Camp CXXXIII we had entered a peripheral region. We shall discover later on that this part of Western Tibet, that is to say the entire region of the Tsanger-schar, did formerly as a fact possess an outlet to the sea, and thus really was peripheral, although through the operation of climatic laws it is now cut off from it and converted into a central, self-contained drainage-region. But it was not until we had got past the Panggong-tso that we reached an actual peripheral region, a region in which the vertical relief is much more strikingly developed than it is in the basin of the Tsanger-schar.

The rock which we encountered was the same as that hitherto met with; at our camp it dipped 51° towards the N. 12° W.

CHAPTER XVIII.

THE TSO-NGOMBO LAKES.

On November 27th we continued our journey down the valley towards the S. 64° W., but only covered 12 km. After the everlasting sameness of the high plateaus we found the Tsanger-schar a very welcome change and were in no hurry to get away from it. In the morning the wind blew quite freshly from the *east*, the first time for three months that we had started with the wind at our backs. In point of fact it seemed to be only the cool night breeze blowing down the valley, for it soon began to die gradually away, and by 9 o'clock it had quite ceased. It was followed by breezes from the south and finally from the south-west, blowing irregularly and in gusts.

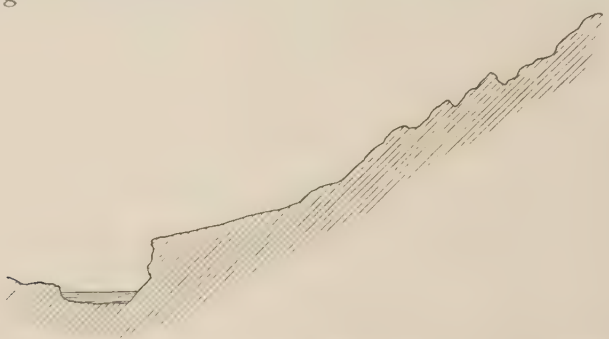


Fig. 160. VERTICAL SECTION IN THE UPPER PART OF THE TSANGER-SCHAR.

On our right we passed the big side-glen; one of its branches, opening up towards the east, presented a perspective of the distant mountains. For a considerable distance we marched along the fringe of the flat gravelly scree belonging to this glen; next the river it consisted of coarse gravel, forming an almost level expanse. Curiously enough, just at this spot there was, growing alongside the stream, a belt of balghun bushes bigger than any we had hitherto seen, their stems being as thick as those of small trees. One would think that here, on a delta of sediment and gravel, they would be less protected than in places where no glen debouches. These are however the only vegetation that exists; except for them the ground is barren, the gravel showing grey and bare amongst the bushes. All the way the

THE TERRACE AT CAMP CXXXVI

LOOKING S. 64° E. FROM CAMP CXXXVII.

gravelly scree was so thickly seamed with deep gullies and water-channels, that, it was evident, the Tsanger-schar receives every year an appreciable influx of water from this side-glen. The scree drives the river over close to the foot of the southern range, so that the screes of gravel, which on that side break out of the transverse glens, have been abruptly shorn off and present high vertical escarpments. The level expanses which sometimes show themselves on this left side of the stream are therefore very small, but nevertheless produce bush vegetation. The mountain-range in that same quarter is steep and massive, its spurs short and craggy; the main chain was seldom visible, though it grows gradually lower towards the west, and finally is quite free from snow. The gravel screes that bulge out between the spurs are much shorter and steeper than those on the north side of the valley.

Fig. 161. LOOKING DOWNWARDS FROM CAMP CXXXVII.

In the vicinity of Camp CXXXVI the valley was fairly broad, but after that it contracts. We kept to the northern bank of the river, having close on our right the steep, shorn edge of the gravelly scree, often a vertical wall as much as 10 m. high. In the face of the escarpment the various layers of gravel-and-shingle, sand, and fluvial mud were very distinct. One of these screes is especially big, being common to several transverse glens which converge upon it from different directions. Here again extensive sheets of ice had formed, obscuring the river, and below them the stream was divided into two or more arms. The volume may have amounted to about 4 cub.m. Occasionally in the deep places the velocity was only slight; it was these dark eddies that the fish preferred. Wild-duck occurred in several places, and we saw wild sheep and hares. During the last part of the stage the river was quite free from ice, not even the banks being fringed. In places the surface consisted of powdery dust, and on the right or northern bank a path was distinctly visible, being trodden one and sometimes two feet deep into the soft surface, while the grass beside the track was eaten off down to the roots. The bushes

still continued, although interrupted for short distances. The path leads to the temple village of Noh. The sheep caravans to and from Ladak are said to use this path from time to time in the summer.

On the right issues a spring-fed rivulet yielding a fair amount of water. We pitched Camp CXXXVII at the base of a big gravel-and-shingle terrace, forming the edge of one of the usual gravelly screes. The boldness of the relief rendered the scenery attractive. The altitude amounted to 4322 m., or only a few meters higher than the Tso-ngombo and the Panggong-tso. Near our camp the rock consisted of dense, dark limestone, its dip being very distinct at 57° towards the S. 35° E.

162. APPROACHING NOH.

On 28th November we continued our march down the valley, still keeping to the right bank of the Tsanger-schar. The surface generally consisted now of yellow clay and dust, fluvial mud which settled when the river was at a higher level, and broad reaches of the valley were inundated and in part also converted into marsh. The balghun bushes still continued to appear, although more scantily. The valley itself was all the time narrow, though somewhat broader than hitherto, owing to the range on the north having receded. The space between the foot of the range and the river is filled with gravelly screes, all showing persistently the same steep, shorn edge, frequently gapped by gullies and watercourses, which looked like dark, narrow gateways. Here again the river creeps close in to the foot of the southern mountains. The water that came from a spring on the right side of the valley had a temperature of + 4.5°. On the south is the outlet of a larger glen, which higher up appeared to run to some extent parallel with our valley. Beyond that rises the great precipitous bluff, at the western foot of which the village of Noh is situated. The river hugs closely the northern foot of the precipice. On the right bank of the river comes a relatively wide flat, plentifully overgrown with bushes, some of

them of great size and with thick stems. According to our Tibetans, the privilege of using this scrub is reserved for the adjacent temple village, and we saw stacks of it piled up to dry on the roofs of several houses in Noh.

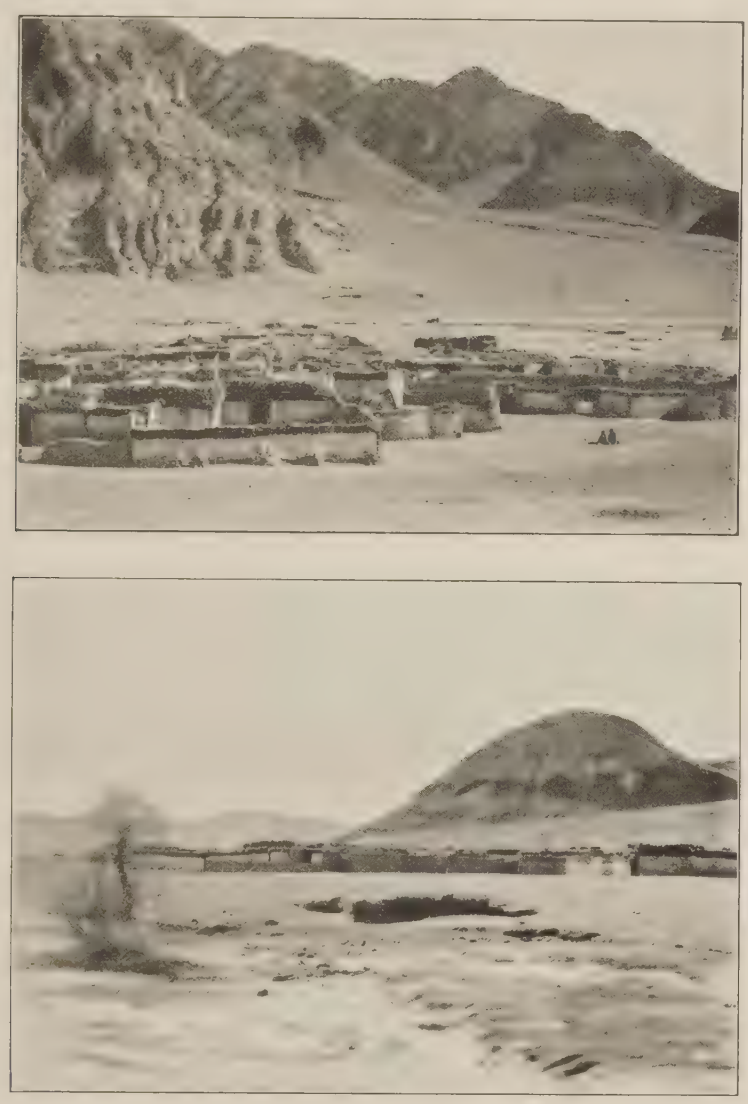


Fig. 163. VIEWS OF THE VILLAGE OF NOH.

Both valley and river wheel at right angles round the big bluff just spoken of and then run south, debouching upon an unusually open country, namely the flat depression in which the lakes of Tso-ngombo are situated. The last transverse glens of the northern range join the valley just at the elbow, and the last spurs and gravelly screes of the same range approach the bank of the river so closely that there was barely room for the camels to get past. At one point we crossed over an offshoot of the gravel-and-shingle terrace, the foot of which is washed by the

river, but the river was too deep for the camels. On the left bank of the river, and between it and the big bluff, stands the village of Noh, called also Odschong, the first permanently inhabited place, as it was also the last, that we encountered in Tibet. A little distance from the village stand the temple buildings, red and white, with bulbiform cupolas and flags fluttering from high poles. The same colour distinguishes also the square houses, which are clustered together in a clump, and are likewise adorned with flags. At the special request of the inhabitants I abstained from visiting the interior of their village, and contented myself with taking some photographs, and sending into it one of the Buriat Cossacks and our Lama. They reported that the interior of the houses was horribly dirty; felt carpets were spread

Fig. 164. VIEW OF THE VILLAGE OF NOH.

on the floor and there was a hole in the roof for the smoke to escape by. The country around is perfectly barren, and the village wears an air of loneliness and desolation. The last bushes grew in a thicket on the right bank, close down to the water-line. Just below the village the river is spanned by a simple bridge, namely two or three willow trees flung across from piers of stone. That is to say, it was of the usual Asiatic character, and looked anything but safe. The trees had, it was evident, been fetched from a pretty considerable distance. Immediately below the bridge the river makes a sharp bend towards the west-north-west. Its water was perfectly transparent and of a gloriously dark green colour. For a short distance the river was divided into several arms, but these soon became concentrated into one, a very sinuous channel, winding between deep-cut erosion-terraces, the one on the left being especially developed. We kept to the right bank, where there was a small secondary ridge, with springs gushing out at its foot; the water of one of these had a temperature of + 15.9°. Below some of these springs little pools had formed; they contained Algæ and were then frozen over. From the point where we first struck the Tsanger-schar, and all the way down to the present spot, the

Lyostr. A. B. Lagerings & Westfys.

THE VILLAGE OF NOH.

river had continually increased in volume owing to the many spring-fed rivulets that run down to meet it, so that the statement of the Tibetans, that the water it then contained came from perpetual springs, would appear to be correct.

Two years later Captain C. G. Rawling travelled down beside the same river. He calls its upper part Kheo Lungma; but the name of Shankar Shah, which he gives to his Camp 81, clearly corresponds to my Tsanger-schar or Tsangar-schar. He also touched Noh, and then travelled as I did north-westwards along the northern shore of the Tso-ngombo.

Fig. 165. LOOKING N 72° W FROM THE PASS OF NOVEMBER 28.

A minor side-glen issuing from the north compelled us to make a detour to the north in order to get round several pools formed by springs and the marshy ground which they give rise to. Although the general slope of the strata was towards the north, that locality abounded in springs. South of the river stretches an extensive plain, with hard, barren, gravelly soil, and at a considerable distance in the same direction there were what appeared to be several parallel mountain-chains. All we could see of them were their mere outlines, so that we were unable to form any clear idea of how they are arranged. The middle of the plain that stretches north from these mountains is occupied by the eastern part of the lake of Tso-ngombo, though it was screened from us by hills. In the south and south-south-west were some conspicuous pyramidal snowy peaks. At length we turned away from the river, which flowed on towards the south-west past the southern extremity of a little offshoot of the hills. The current was moving slowly and silently, so that for this reason, as also because of its depth, the river seemed greater than it really is; all the same the volume did not, I suppose, exceed 4 to 5 cubic meters in the second.

After passing on the right bank of the river, that is to the south-west, a solitary tent, we began to climb, westwards and north-westwards, slowly up the gravel-and-shingle hills that constitute the last offshoots of the big mountains rising

immediately to the north. The numerous eroded watercourses, by which these gently rounded hills are seamed, made a convenient path by which to ascend to a little pass garnished with a stone *obo* and flag-staffs. It was from that spot that we obtained our first impressive general view of the Tso-ngombo, with its islands, bays, and the steeply sloping mountains that ring it round, the whole forming a remarkably attractive picture and at the same time presenting an agreeable change in the character of the scenery. Nevertheless from that point of view we were not able to gain a completely satisfactory idea of how the outlines of this eastern lake-basin run, and consequently I am unable to offer any fresh data beyond those already known from the maps of English travellers.

Fig. 166. LOOKING S 19° W FROM THE PASS OF NOVEMBER 28TH.

The following features stand out however with especial distinctness. From the southern shore there juts out a peninsula, the eastern extremity of which bore S. 22° W., while its narrow isthmus or connecting neck of land bore S. 41° W. Beyond the peninsula there appeared however to be nothing except a bay of little real consequence. To the S. 19° W. we saw a number of flat mud islands, stretching from east to west. Although from our then point of vantage we were unable to see the embouchure of the Tsanger-schar, it is fair to assume that these mud islands were formed by that river, the sedimentary matter being brought down at the season when the stream swells and when its volume must be really very considerable. In the S. 88° W., on the southern shore, rose the culminating summit of a minor butte; the eastern extremity of the same short range appeared in the S. 70° W.

Opposite our outlook the lake appeared to be $3^1/_2$ km. across, but towards the N. 70° W. it contracted a good deal. In that quarter was a little island in the middle of the lake, the western half of which consisted of a small rocky bluff, with a stretch of level ground at its eastern foot, that is on the side sheltered from the west wind; on this bushes were growing fairly plentifully. The lake appeared to

extend a good long way towards the east or east-south-east, although it was for the most part screened by hills.

Along the northern shore runs a broader strip of strand, and behind it the gravel-and-shingle hills rise precipitously. This strip is sandy and grassed over, and there the sheep caravans from Ladak are wont to halt beside a couple of elongated marginal lagoons. Immediately at the back of these hills, which are very sharply defined next the flat strand, come steep foot-hills, and beyond them again the great rugged masses of rock.

Fig. 167. MARCHING DOWN TO THE TSO-NGOMBO.

We pitched Camp CXXXVIII near the western end of this flat strip of shore, choosing the point that would give us easiest access to the fuel on the island. A beach-line, running at about 1 m. above the then existing level, appeared to indicate that the lake will sometimes rise higher than it was at that time (winter); though it may also be the result of the continuous shrinkage of the lake, or may be quite simply caused by the beat of the waves. The only place in which the lake was not frozen over was where the river empties into it, and in the vicinity of the island there were a couple of open »lanes» through the ice. Everywhere else the entire extent of the lake was sheeted with ice. Yet it was only in the narrower parts, for instance the sound between the island and the shore, that the ice was strong enough to bear; farther out it thinned away to a mere film. Between the shore near our camp and the eastern extremity of the island we obtained the following soundings — 1.65, 4.45, 5.23, 6.35, 3.60, and 1.36 m., the lake there being thus rather shallow. In all probability there are greater depths in the middle; although, to judge from the flatness of its shores, the whole of this eastern part is fairly shallow. The lake, like the river, swarmed with fish, and they were especially easy to catch around the island, on which some fresh springs issued. The water of two of these

had a temperature of 10.7° and 9.8° respectively; it was these that kept the lanes open through the ice. Between the island and the shore, the ice in the thinnest places was nevertheless 12 to 14 cm. thick. It is said to last to the end of March and generally to break up pretty quickly. In winter the west wind prevails and generally blows hard, often bringing with it copious falls of snow. On 29th November, whilst we were resting at this place, the sky became heavily overcast at 11 a.m., the clouds driving furiously east, and an hour later there burst upon us a tempest from the west, which whirled up dense clouds of dust and sand. But by 9 p.m. the sky was almost clear, the clouds having for the most part blown away again.

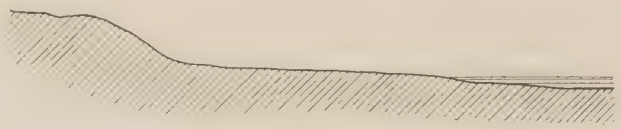


Fig. 168. THE FLAT STRIP OF SHORE.

On the 30th November we made an interesting journey beside several of the detached basins of the Tso-ngombo. In what follows I use the name Tso-ngombo to indicate all the freshwater lakes in contradistinction to the Panggong-tso, the large saltwater lake lying farther west. Tso-ngombo was the only name that was given to me; on the other hand, I never once heard the special names — Tso Nyak, Rum Tso, and Nyak Tso — which are entered on Captain Rawling's map; these names appear again on Sheet 63 A of the large Indian map, the sheet bearing the signature of »Captain T. G. Montgomerie, R. E., and Assistant Surveyors», its date being 1874.

Fig. 169. VIEW OF THE RIVER-ARM OR CONNECTION BETWEEN TWO BASINS OF THE TSO-NGOMBO.

Soon after leaving camp we found that the flat shore narrowed suddenly, the grey gravel-and-shingle terraces leaving but a mere fringing strip next the lake. At the foot of the terraces there issues a spring, which gives rise to a couple of small open basins. Springs burst out here along the actual water-line, and an occasional »lane» through the ice betrayed that others gush up in the bottom of the lake itself. We were now able to see the western side of the little mountain bluff; it, as also the southern side, goes steeply down into the water, but on the other two sides, the north and east, is the level ground on which the bushes were growing. On the north there opens out a not inconsiderable glen, squeezed in between rather big mountainous offshoots; it was plain to see that it was made up of several converging glens. Leaving the island behind us, and with it also the smaller detached bluffs on the southern shore we bore away from the lake side and struck in between two quite independent ridges. By this the lake had contracted to its smallest, and finally it terminates in a quite short river-arm, or rather a sound, which

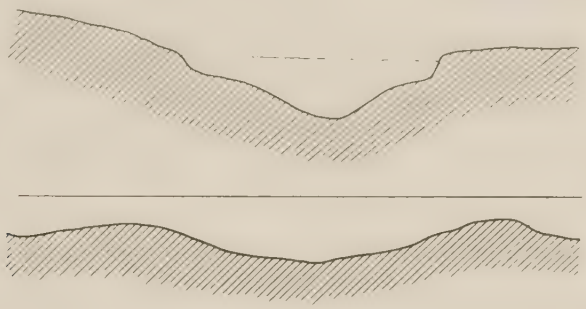


Fig. 170.

connects it with the next lake-basin. We then followed the northern shore of the new basin towards the north-west. The sound was quite free from ice, but the new basin was frozen over. This is quite insignificant in size, and soon ends in a point. Along its southern shore runs a range of moderate elevation, seamed with a number of transverse glens; while on its northern shore is a quite small range. Between the latter and the water the strand is level and the path distinct. Another river-arm proceeds out of the western extremity of this basin, being a continuation of the other already mentioned; it is composed partly of the Tsanger-schar and partly of water from innumerable springs that issues into the extreme eastern section of the Tso-ngombo. This river-arm meanders slightly, but otherwise is inconceivably regular in its formation; in fact it resembles an artificially made canal, being about 12 m. broad, and with an average of about 3 m. in depth. There was a decided current, though its velocity was barely more than one or two decimeters. The water was as bright as crystal and of various shades of lovely emerald green. Its bottom appeared to consist entirely of yellow sand, occasionally overgrown with Algæ; in point of relief however it is very irregular, containing numerous deep pits into which the fish were collected. The accompanying illustration (fig. 170) gives a view of it both in cross-section and in longitudinal section. Two dm. above the then existing level was a beach-line, showing that the lake was at that season dropping. There were

also other beach-lines or rather terraces; but they belong to an older period, when the lakes were larger in consequence of a more abundant inflow of water. At one place only did we observe a few blades of grass growing close in beside the shore; though very near to them were some smaller sand-hills, held together by short, hard

Fig. 171. LOOKING WEST FROM CAMP CXXXIX.

Fig. 172. LOOKING NORTH FROM CAMP CXXXIX.

grass. This section of the river was also perfectly free from ice, and emptied into a third independent lake-basin, which on the contrary was almost entirely frozen over, except for a few open strips of water in the middle, probably due to the current from above.

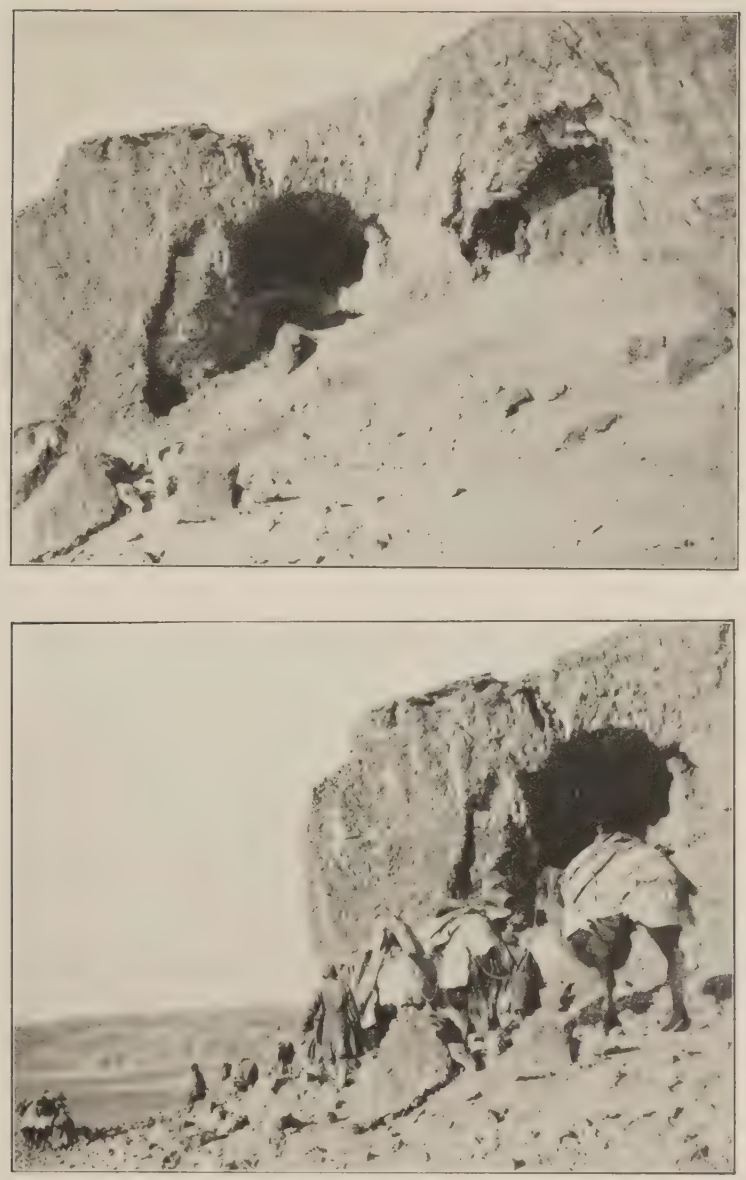


Fig. 173. GROTTOES ON THE SHORE OF PANGGONG-TSO.

This third lake-basin is of about the same dimensions as the second. We marched beside it due north-west. In some places the offshoots of the northern range approach quite close to the shore, choking it with vast gravelly screes, on which scrub grows but seldom. The range along the southern side continued and its offshoots reached down to the water's edge. It is wild, craggy, and broken up by a great number of side-glens; it culminates in sharp pyramidal peaks, but without snow. Just opposite the end of the lake a big transverse glen breaks through from the south, consisting of two subsidiary glens, one coming directly from the

south, the other from the south-west. At its outlet is a gigantic gravelly scree. Over against this glen we, on the other side of the lake, entered a more open locality, having to the north-west a dominating peak at the head of a large valley.

Fig. 174. GROTTOES ON THE SHORE OF PANGGONG-TSO.

The river next enters a tiny basin, at that time entirely frozen over, and after that a larger basin, bigger than any of those it had hitherto passed through, and extending a long distance to the west and north-west. This, the fifth basin, was not frozen, but under the crisp breeze its dark green waters were curling in white foam-tipped waves. Its eastern shore, especially where the lake is narrowest, was

WIEWS OF THE TSO-NGOMBO.

fringed with a belt of ice 10 to 20 m. broad. This evidently owed its origin to the fact that during the cold, bright nights a thin sheet of ice would cover the lake, and this next day would be broken up by the prevailing wind and driven east, where it banked itself up into a solider mass. The cause of the rest of the lake not being frozen must be its great depth, though possibly this result may also be in part due to its greater exposure to the wind, which sweeps with augmented intensity between the mountains that shut it in on either side. But there could be no doubt that it would not be long before this basin also would be frozen over. Hundreds of wild-duck were swimming about on the water.

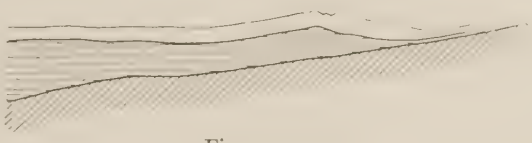


Fig. 175.

Except for unimportant bays and capes the shore of the lake extends towards the north-north-west. The cliffs approach quite close to it, and at their foot the ground is covered with immense screes of stones and gravel, sloping more or less steeply to the water's edge. These rendered it difficult to march, especially for the camels. In one of these lake-side cliffs we discovered a grotto, which had recently been inhabited. Camp CXXXIX was made at Bal, the broad outlet of a glen upon which several subsidiary glens converge; this evidently had once been a northern bay of the lake. At its head we again perceived the recently mentioned dominating peak (T_4); to the left of it the route to Niagzu runs up through the mountains. At Bal a little brook with bright, unfrozen water entered the lake; it clearly issued from springs. Although its volume was not more than $^1/_5$ cub.m., its eroded watercourse is of great size and excavated to I daresay the depth of 5 m. and shut in by steep, often vertically scarped banks. Close to our camp a second similar glen opened out into the first one, but contained no water. There was at that time no grass on the plain at Bal, nothing but dry japkak as hard as wood.

Thus in the course of this day's march we had followed the river Tsanger-schar towards the north-west, tracing it down a big latitudinal valley and through five lakes, which might very well be described as expansions of the river. These several expansions or lake-basins may be regarded as lying at precisely the same level; anyway the velocity in the sounds or river-arms that link them together was altogether insignificant, so that the fall towards the west is infinitesimally small. The basin farthest east, which is incomparably greater than the others, may be looked upon as the true gathering-basin of the lake-system, which receives its supplies from over a very extensive area, the Tsanger-schar being its principal contributory. Out of this lake the water flows slowly towards the north-west, and finally enters the Panggong-tso, which lake possesses no outlet, and consequently is salt. In spring and summer, after the snows melt, and in the late summer, during the rainy season, vast quantities of water flow into the eastern basin, and this sets up a much livelier current in the sounds that connect the several basins. It is at this period therefore that the beach-lines are made, and it is in these little sounds that they are most developed. The fringe of ice along the shores appeared to indicate that the smaller lakes had dropped somewhat since the ice formed; for the ice sloped down from the outsides towards the middle. Nevertheless reports in the ice-sheets

betrayed that displacements were taking place even then, and ridges and cracks showed in places near the shores (fig. 175).

It may be said as a rule that this string of lakes grows increasingly deeper towards the west. The eastern basin of the lake lies in a flat, open valley and is clearly very shallow; towards the western extremity we found later on that the depth amounts to 48 m. This difference is of course caused first of all by the original shape of the valley, but is also due to the subsequent progressive filling up with sedimentary matter. It is in the eastern lake-basin that the greatest quantity of solid material is deposited; consequently it fills up the fastest, and is now therefore the shallowest. By the time the water reaches the basin which has Bal on its northern shore

Fig. 176. A DIFFICULT PLACE ON THE NORTHERN SHORE OF EASTERN TSO-NGOMBO.

it is clarified and pure after passing through the upper basins. As is evident from its colour, the Bal lake is considerably deeper than those above it. All the same these lakes receive direct contributories out of the numerous side-glens, and consequently they too are being filled with sediment, though of course at an extremely slow rate. For instance, the fourth lake, which is very small, looks as if it would soon be completely filled by the river that issues out of the big transverse glen on the south. Thus there are two factors contributing to blot out the Tso-ngombo and Panggong-tso entirely from the face of the earth — (1) the progressive sedimentation or filling up of the lake depressions with solid material, and (2) the climatic changes, caused by the decreasing rainfall, changes which, as we had abundant opportunities for observing, are taking place in the lake depressions all over the interior of Tibet. Farther on we shall also discover all too evident proofs that these lakes in western Tibet are likewise contracting.

All day it had proved impossible to cross over the water to the opposite shore, for the channels were everywhere deep-cut and the ice did not bear.

In the narrow passages, where it ought to have borne best, it was generally weakest or else there was an open lane through the ice, caused by the somewhat accelerated current. Yet even these places would, I feel certain, freeze later on in the winter.

At Bal also we were assailed by a furious tempest from the west. The minimum temperature gradually rose: during the preceding night it was, for example, only — 13°.3.

Fig. 177. SCREE OF BIG STONES.

December 1st. Turning our faces towards the west, we left behind us the broad littoral plain of Bal, with its numerous glens, which there find their termination after pretty long courses through the mountains; at the same time we of course travelled away from the lake-side. To the south-west was a fairly big peak, which continued within sight all day. We crossed over three rather deep watercourses, pretty certainly arms of a delta, which however only carry water after rain or an active melting of the snows. The ground consisted of soft, fine matter, though it was hard and lumpy on the surface, being in fact saliferous schor, with dry japkak roots in it at intervals. A little north of our route the japkak was growing in a sharply defined zone.

Instead of following the shore of the lake we crossed a small, insignificant range by means of a convenient pass, and then ascended to a second small threshold pass by a glen that debouches upon the plain of Bal. From this a somewhat steeper declivity led us down into a fairly big glen, coming from the N. 42° W. and picking up a number of subsidiary glens from both sides. This glen finally terminates at a bay on the north side of the lake. On the inner circuit of the bay two strand-terraces were distinctly visible, the upper one at about 5 m., the lower one at about 1 1/2 m. Within the former was an expanse of yellow clay, consisting of sediment that had been washed down, though it was then perfectly dry (fig. 178).

Fig. 178.

As the offshoots of the mountains now plunged very steeply into the lake, we were compelled to keep close to the water's edge, there being only just room for the path on the narrow scree of gravel and small stones which has been formed at their base. The gravel was as a rule sharp-edged, and in some places we had to prepare the path for the camels, and lead them cautiously one by one. After we had in this way advanced a space towards the south, passing on our left, that is on the east side of the bay, one or two rocky headlands, the shore-line turned abruptly west, and again we had to follow its every indentation and headland; but between the mountain offshoots there occurred every now and again short stretches of soft level ground. The lake was there narrow, seldom more than two kilometers across, and its southern shore was backed by rugged and picturesque mountains of some magnitude. The scenery was magnificent; fresh views continued to unfold themselves unceasingly towards the west. The long-drawn-out narrow lake, the Tso-ngombo proper, or according to the recently mentioned English map the Nyak-tso, is more like a big river winding down its valley and fenced in on both sides by magnificent, boldly sculptured crags, above which conspicuous pyramidal peaks soar up at intervals. Here where the lake is so narrow, it appeared to possess a relatively great depth, though next the shore there was a strip of shallow water 2 to 10 m. broad, in which one or two belts of Algæ were growing. But beyond that, really the continuation of the gravelly scree, the water turned suddenly dark green, a sign of an abrupt descent to greater depths. Unfortunately owing to the hard west wind I was not able to sound this part of the lake. It still continued however to be open, and it was only in the more sheltered bays that a narrow ribbon of ice had formed along the shore: it consisted of wind-driven broken ice, cemented together by thinner recent formations.

Fig. 179.

Where the mountains came down in precipitous walls we were not seldom able to observe old beach-lines. In one place we noticed five such rising one above the other, and to some of them there were corresponding beach-lines on the southern shore, showing up with remarkable distinctness as dark and perfectly horizontal lines. The highest terrace visible on the northern shore reached an altitude of 11.5 m. above the level of the water, although from what we discovered farther west, there were other, though indistinct, terraces still higher up. The lowest terrace, which was 5 m. above the lake, was at this spot of exceptional beauty and distinctness, but it soon came to an end (fig. 179).

From this locality all the way to Camp CXL the shore runs towards the west-south-west, and is indented by three coves, of which the middle one penetrates farthest inland; they are framed about by soft but at that time frozen schor ground.

A DIFFICULT PASSAGE ON THE NORTHERN SHORE OF TSO-NGOMBO

Fig. 180. STEEP SHORE OF EASTERN TSO-NGOMBO.

Fig. 181. NORTHERN SHORE OF TSO-NGOMBO.

The cliffs on the northern side then recede a little and nowhere reach all the way to the shore. The level strand afforded excellent ground for marching on, the surface consisting for the most part of fine dust, with a sprinkling of vegetation; the dust rose in clouds in the track of the caravan. On the shore stood a solitary Tibetan tent, the inhabitants of which clearly intended to remain some time longer, to judge from the big stacks of fuel (wood) built up round the camp and obviously intended for winter use. A flock of sheep was grazing on the thick, though then

hard and withered grass. In the N. 30° W. was the wide outlet of a fairly big glen, which is joined by several subsidiary glens from both sides. Occasionally we would meet on the northern track a caravan of sheep, laden with corn put up in small sacks, and travelling from Leh or Tanksi. One that we met this day consisted of

Fig. 182. THE DIFFICULT PASSAGE OF DECEMBER 1ST.

200 sheep: it was quite a pleasure to see how well-trained the animals were, and how orderly they marched along without being especially looked after. Just after passing a little patch of balghun bushes we formed Camp CXL. At this point the lake was barely a kilometer in breadth. In the S. 36° E. we observed a conspicu-

ous headland on the southern shore and to the east of it a bay cutting relatively deep inland, and backed by an especially big glen, which apparently would afford access to the heart of the mountains on the south.

The water still continued to be of a dark colour, pointing to a considerable depth, and the bulk of it had not yet cooled sufficiently to admit of the formation of ice, which was also retarded by the heavy insolation and by the wind, as also by the tempests of the preceding night or two. But we were soon to learn that a short spell of quietude in the atmospheric conditions was alone needed for the entire lake to become ice-bound.

Fig. 183. STRAND-RAMPART.

For an account of the rocks that compose the mountains on the north side of the lake, I refer the reader to the Geological section of this work. Generally the mountains are rugged and bare, with capricious and irregular outlines. All the finer materials were blown away long ago; even the gravelly screes at the foot of the mountains consist exclusively of coarse material, the interstices of which are not filled up with any finer matter. This alone suggests that it is a windy region, and in fact both mountains and lake-shore were swept as clean as a barn-floor; such fine pulverulent matter as does remain on the latter is retained partly by the compact nature of the schor, partly by vegetation: it was only in one sheltered bay that we hit upon soft dust that whirled up in the wind. Here again older beach-lines often show up distinctly on the rocky walls, while mollusc shells are pretty common on the shore.

Quite close to our camp a very narrow offshoot of the mountains terminates abruptly in the lake itself. This, while offering no insuperable difficulty to yaks and sheep, and even to horses, is nevertheless impassable for camels. But at the base of the cliff there is a shallow abraded shelf, one or two meters wide, and

along this, after we had chopped away the fringe of ice which had formed there, we led our camels. The annexed photographs will give an idea of what the place looks like.

December 2nd. The track keeps close to the shore, at one or two meters from the water's edge, seldom at one or two hundred meters where the beach is level, and it follows with irritating loss of time every winding of the shore. Every now and again we came across a thin clump of bushes, almost always growing at the edge of the flat gravelly screes, which spread out opposite the ends of the glens on both sides of the lake. The indications of former higher water-levels assumed the form partly of terraces, partly of merely lighter-coloured lines and shelves; the

Fig. 184.

Fig. 185.

former frequently have abrupt edges. There are lines too on the southern shore, corresponding to those on the northern shore. In the coves that lie below the outlets of the glens, with soft material for their floor, we were often able to observe ramparts sharply and distinctly marked and regularly rounded, and ranging at different elevations. They are however different from the ridges which in practically every bay run close along the water's edge. These latter consist of earth, mud, and clay and are seldom more than 1 m. high. Their shape alone betrays that they were formed in a different way from the flat ramparts that lie farther back from the water-line. Both faces are very steep, and more particularly the inner one is generally vertical, sometimes indeed even overhanging (fig. 184). There can be no doubt that this ridge owes its existence to ice-pressure in the spring, when the lake rises, set- ting the ice in motion, whereupon the wind presses it forcibly against the shore. But we only observed this ridge in the bays, nowhere on the capes.

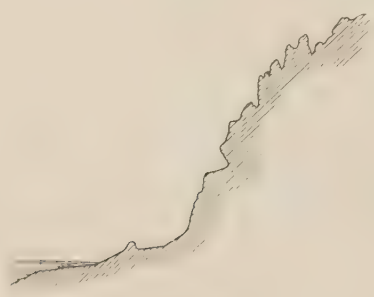


Fig. 186.

Most of the capes coincide with buttresses and offshoots from the range on the north, so that there is generally but very scant room left for the track. In some places, as the accompanying illustration (fig. 185) shows, the actual cape is undermined by the combined wave-beat and ice-pressure. Here too at the base of the rocks there is as a rule an abrasion terrace, but little more than 10 m. broad, with two belts of Algæ growing on it, and beyond that the water of the lake is dark, without any lighter tints to indicate shallows. These capes frequently show in profile as in fig. 186. At the foot of one of these capes, consisting of granite, a heap of immense stones had accumulated; here we had to make a road, as well as unload some of the camels, in order to get past. When the rocks on the southern shore are thrown into the shade in the afternoon, so that their projecting headlands

Lithstr. A. B[illegible]lius & Westphal.

DIFFICULT PASSAGES ON THE SHORE OF THE TSO-NGOMBO.

CAMP CXLI.

CAMP CXLI.

Fig. 187.

wear in part a gloomy aspect, the capricious and fantastic relief comes out with far more telling effect than when they are bathed in sunshine, for then a multitude of their details are obscured. The lake varies continually in breadth, being narrowest when two headlands approach each other from the opposite shores; indeed it is everywhere so narrow that the scenery entirely changes after but a very short stretch. In the morning before sunrise, we observed a remarkable phenomenon off the southern shore, south-east from the camp: the lake »smoking» over a not inconsiderable area. Clouds of steam, just as intensely white as the steam from a locomotive, were rising from the surface of the water and were being wafted across the lake by a gentle breeze from the south-west, until they thinned away and disappeared. But the formation of the steam ceased a short while after the sun rose. The cause is evidently a number of relatively warm springs issuing on the shore; anyway the lake water is considerably warmer than the air prior to the appearance of the sun. The narrowest reaches of the lake, beside which we travelled during the first half of the day, were covered with a thin sheet of ice; but after the lake widened out again, it was unfrozen, with the exception of a narrow fringe along the northern shore. Clearly it wanted but one or two cold nights, and this part of the Tso-ngombo would also freeze, and the Tibetans fully expected it would freeze, for once or twice they inquired of people whom they met whether the lake farther west was frozen or not.

Fig. 188. CAMP CXLI.

On a small pointed promontory there were some freshly formed terraces or ramparts, arranged radially in the way shown on the accompanying illustration (fig. 187), in that they all ran out towards the extremity of the promontory. They consisted of gravel and sand, and were hard and very regularly built. The higher, inner ones

date, I have no doubt, from a somewhat earlier period, the lowest belong to the present time. If we suppose the surface of the lake to drop a stage further, similar small ramparts would once more be formed next to the new shore. Ramparts of this description were very common during the day's march, both on the promontories

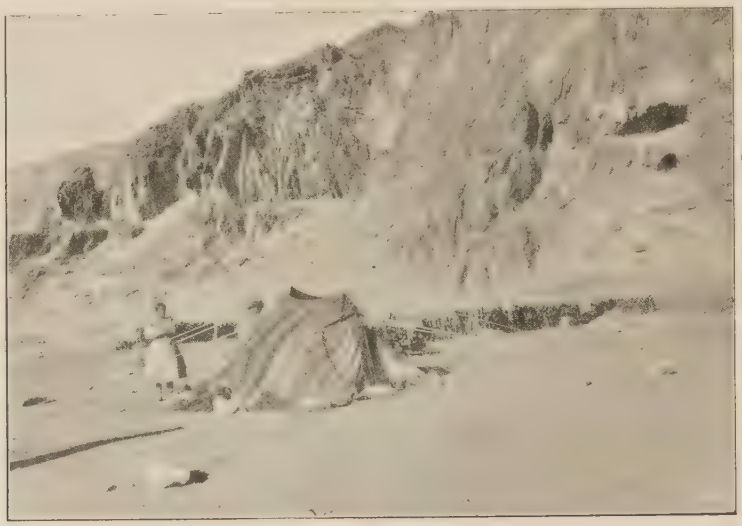


Fig. 189. TIBETAN TENT AT CAMP CXLI.

Fig. 190. FROM THE NEIGHBOURHOOD OF CAMP CXLI.

and round the bays. After that came a large promontory, consisting virtually of perfectly level, sandy ground, with a couple of beds of excellent kamisch growing on it. The strip of beach now became wider than it had been before. In the south-south-west we perceived a larger bay, with an especially big pyramidal peak at

Fig. 191. LOOKING S 32° E FROM CAMP CXLI.

192. LOOKING WEST ACROSS THE LAKE FROM CAMP CXLI.

the head of it, though it was soon screened again by nearer mountain-masses. Upon this bay debouches a big glen from the south.

During the latter part of the day's march the ground was especially favourable, consisting of soft earth, with kamisch, grass, japkak, and balghun bushes growing on it at intervals. Such localities as this show clearly that there is a fairly lively traffic between Ladak and Noh; the road is made up of quite a number of parallel tracks, pretty deeply trodden. Across the gravelly screes the track disappears almost entirely amongst the stones. At Camp CXLI we found a sheep caravan already encamped. The sheep were grazing along the shore. Their three

conductors had put up their black tent close to the nearest mountain wall, and in a circle round the tent they had packed up the sheep's loads, namely several hundred double sacks of corn, the usual caravan commodity. On the journey out to Ladak the sheep are generally laden with salt. Thus it is a barter trade that the Tibetans carry on in this region.

At Camp CXLI we saw on the nearest slope an extraordinarily distinct terrace. The rocks this day consisted of different varieties of grey granite and schist, though in the vicinity of our camp it was black and greatly compressed. It was in the last-named rock that the terrace was sculptured in the way shown in the accompanying illustration (fig. 179), and it was so regular that one might have been tempted to take it for a road, made at a time when the lake stood at a higher level than it does now, a view that is however altogether precluded by one fact alone, namely on the opposite southern shore there is an exactly corresponding terrace.

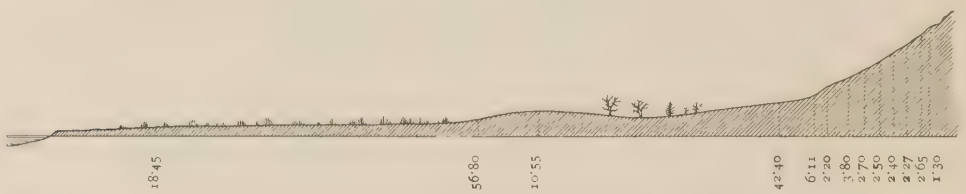


Fig. 193. VERTICAL SECTION OF THE TERRACE AT CAMP CXLI. THE FIGURES INDICATE THE DISTANCES IN METERS BETWEEN THE STATIONS.

I took a levelling of the lake-side, starting from the water's edge; the horizontal limb of my levelling tube was exactly 1 1/2 m. above the ground. On the water-line itself there was a little transverse terrace, with a strip of shore behind it, 75 m. broad, reaching up to the base of a rocky wall 3 m. higher. This strip of shore is covered with tangled kamisch, which had been severely grazed. The rampart, which farther west is double, consists of sand and gravel, is very hard, and at the point where my levelling-line intersected it, its top was 4 1/2 m. above the surface of the water. Its ridge is of course uneven, being more eaten away in some places than in others. On the inside of this rampart there is a depression about 40 m. broad and covered with sediment; there the rainwater appears to gather every now and again, and a few solitary bushes were growing. Behind that comes a smaller gravelly scree, and beyond that again the steep flank of the mountain. The terrace, the only one visible in that locality, reaches an altitude of 19.5 m. above the level of the lake.

On 3rd December, we accomplished only a very short stage along the northern shore of the lake, for we soon encountered a broad rocky headland, which the Tibetans declared that the camels could not possibly get over. The weather was at length calm, indeed the wind was perfectly quiescent; accordingly I seized the opportunity to take some soundings in this part of the Tso-ngombo. This mission I entrusted to one of the Cossacks, and he rowed from the camp towards the S. 69° W., making for the extremity of a peninsula which juts out from the northern shore; there I agreed to meet him, while the caravan continued its journey westwards.

CAMP CXLIII.

The shore of the lake still continued to sweep westwards with the usual gently undulating outline, though in this part there are no rocky headlands to impede one's march. The eastern side of the peninsula just mentioned runs in a straight line towards the south. The surface was sandy and earthy, and overgrown with grass,

Fig. 194. VIEWS TO THE EAST FROM THE PENINSULA.

and in it a great number of small rodents had burrowed. The peninsula projects so far out into the lake that between its blunted end and the opposite shore the distance is only 515 m. But immediately west of this sound the lake at once broadens out, there being bays on both sides of it. In the sound just mentioned

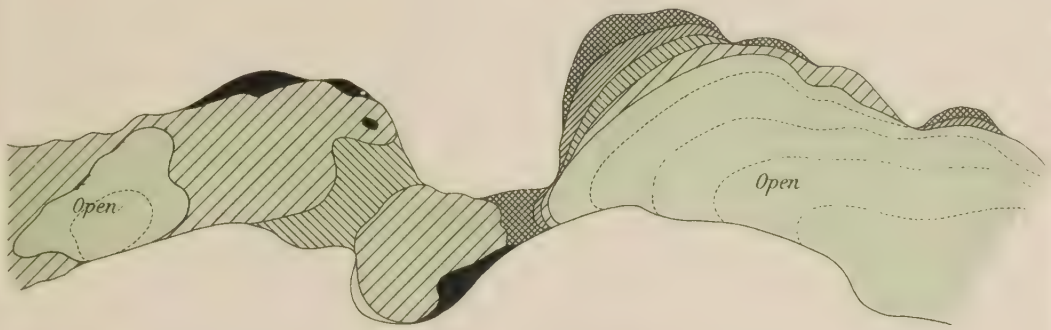
the water was frozen and the ice was strong enough to bear, thus forming a bridge right across the lake. The ice was in different places 13.4, 13.7, 14.3, and 15.2 cm. thick, so that here we might easily have convoyed the caravan across, as indeed I had intended to do, so as to avoid the impassable promontory which I have before spoken of. But a reconnaissance told us that the southern side of the lake was even more difficult than the northern; for it thrusts out three rocky capes, which a pedèstrian can only pass with difficulty, while the lake contiguous to them is 1 to 2 m. deep. Besides, a little west of the narrow passage in the lake a glen debouches, which again would have been impracticable for camels. Another transverse glen opens out upon the northern shore, with a pinnacled summit at its head, and in its vicinity there is reported to be a pass, which is time and again made use of by wayfarers who are reluctant to risk the steep cliffs that overhang the lake on the north. Yet even that pass is impossible for camels; accordingly we had no alternative but to make the attempt to get somehow or other round the difficult passage, otherwise we should be forced to go back as far as Bal and take the road viâ Niagzu.

From the appointed rendezvous on the broad, flat peninsula the shore-line continues towards the north-west, and after that towards the west-south-west. The eroded watercourse that issues out of the recently mentioned big northern transverse glen is 2 to 3 m. deep and generally 10 m. broad, but at that time it did not contain a single drop of water. After that the strip of shore narrows again considerably and bushes once more make their appearance at the foot of the cliffs. The bushes seem to thrive best amongst the gravel on the slopes, but are usually absent entirely on the level beach. On the southern shore the bushes are more plentiful than on the northern shore, at all events in this part of the lake. We pitched Camp CXLII amid a little clump of balghun bushes, which furnished us with an inexhaustible supply of first-rate fuel.

Ice between Camps CXLI and CXLII on the

TSO-NGOMBO

Dec. 3



Open water beside hot springs

Very strong ice

Not quite reliable ice

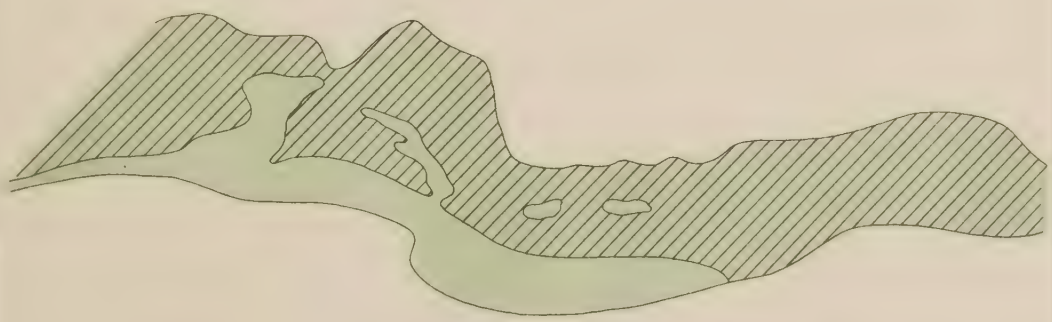
Thin, weak ice

Ice one night old

Lines of progress of freezing

Ice on the **TSO-NGOMBO** near Camp CXLIII

Dec. 4



Thin ice

Open water

Gen. Stab. Lit. Anst. Stockh.

CHAPTER XIX.

ICE AND SOUNDINGS IN THE TSO-NGOMBO.

The sketch map which I herewith add (see Pl. 50) will convey some idea of the way in which the different parts of the lake freeze, a matter which is intimately connected with its geographical situation, its wind relations, and so forth. It was precisely at this time, just in the beginning of December, that the lake began to freeze for good. The first places to freeze are the inner, sheltered parts of the bays, where a crescentic fringe is formed, the outer edge of which is next day shattered by the waves and out of the fragments a small ridge or rampart is built up. Outside of this a fresh crescentic fringe is formed the next cold night that comes. In the bay which lies east of the peninsula four successive fringes were noticeable, separated from one another by ridges of ice of different colours, some of it being white and full of air bubbles and some as bright as glass. From this I inferred that the ice would continue to be formed during the immediately succeeding nights in the way indicated by the dotted lines on the sketch-map. The outside fringe, the fourth, which had evidently been formed during the immediately preceding night, was as thin as paper; whereas in the narrow passage before mentioned the ice was, as I have said, as much as 15 cm. thick. The ice-bridge that spanned the narrow passage was 100 m. broad, but widened out a good deal next the shores. On the east this stronger bridge was flanked by a narrow fringe of recently formed ice; but on its western side fragments of wind-driven ice were packed together and were gradually freezing fast to that which had been recently formed. Along the southern shore, especially in the bay, there was a narrow lane of open water next the land, for several springs exist there at the bottom of the lake. The positions of six of them were easy to fix, because the water was boiling up and all in commotion. One or two of the springs were however so feeble, or else they were situated relatively so deep, that they were only able to keep open a small round hole in the ice. In the basins of this lake farther to the east we had generally found a long narrow lane of open water just at those points at which the respective lakes are narrowest, this being evidently a result of the current. The narrow passage of which I have spoken was on the contrary frozen hard, a circumstance due in no small degree to the fact that no current sets through it; if there were a current it would

not be noticeable in consequence of the great depth and the relatively considerable breadth, amounting to 515 m. West of the ice-bridge came first a stretch of thin ice one night old; then an area of somewhat thicker ice; then a second stretch one night old; and after that open water, sufficient to allow us to paddle across the lake in our skiff; finally, beyond this open belt, a thin lamina of ice. That the freezing of the lake proceeds in the way shown on my sketch-map is thus due in part to the shelter afforded by the projecting peninsula and in part to the fact that the wind blows from the west. Most of the ice had obviously been formed since the last storm; and during the ensuing still nights all this middle part of the Tso-ngombo became entirely frozen over. Probably however the water above the springs along the southern shore remains unfrozen all winter; and along the northern shore also a strip of water is kept open by relatively warm spring-water.

Unfortunately in consequence partly of the strong wind, and partly of the ice, which would neither bear nor break, it was impossible for me to carry out systematic and complete series of soundings in the Tso-ngombo. It was not until we reached this middle part of the lake that I was able to take three series across it, and thus obtain at least some sort of an idea of its true bathymetrical relations; although it would of course have been far more interesting to have been able to get a sufficient number of soundings throughout the whole of the lake to define the relief of its bottom; for possibly they might have suggested conclusions pointing to a presumable connection between this string of long narrow lakes and a former ice-stream. It is true, glacial scratches or other signs of a vanished glacial epoch were no more observable here than in any other part of Tibet; nor should that excite any surprise when the intense local disintegration is borne in mind.

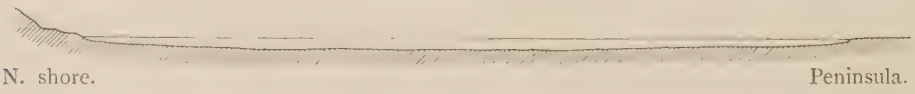


Fig. 195. 17.65 29.57 30.00 29.43 19.30 15.50

Breadth = 4,380 m. Horizontal scale = 1 : 40,000. Vertical scale = 1 : 20,000.

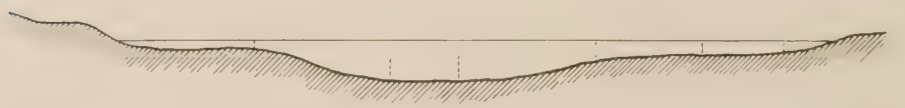


Fig. 196. South. 5.12 29.27 29.36 14,90 9.37 8.40 North.

Breadth = 515 m. Scale = 1 : 5,000.

The first of my three sounding-lines was drawn from Camp CXLI to the south-western extremity of the blunted peninsula, and gave the profile shown in fig. 195. From this it appears that the lake-bottom slopes from the shore rather steeply towards the deepest part, in which the bottom is very level, the depth being between 29 and 30 m., while the very deepest sounding which I obtained was exactly 30 m. Quite close to the shore of the peninsula the depth amounted to as much as 15.5 m. Possibly there are even greater depths near the southern shore in the tract east of the peninsula, and this becomes conceivable when we consider the annexed

THE DIFFICULT ROAD OVER THE MOUNTAINOUS PROMONTORY.

BEGINNING OF THE DIFFICULT MOUNTAIN ROAD AT CAMP CXLIII.

NEAR CAMP CXLVIII.

sketch (fig. 196), which shows the line of soundings diagonally across the narrow sound; there too the greatest depth was found nearest to the southern shore. Along the second line I took six soundings through holes in the ice, this being, as I have said, at least 13.4 and at most 15.2 cm. thick. The depths, going from south to north, were 5.12, 29.27, 29.36, 14.90, 9.37, and 8.40 m. At the distance of about 80 m. from the southern shore there was a shallow, which approached close to the surface, and was easily visible through the ice. If now we bear in mind the considerable area of the vertical section which belongs to the narrow passage, and remember how small is the inflow into the lake from rivers and brooks at the season we are considering, it is not surprising that the movement of the current through the passage should be so infinitesimally slight, and that it should in no way serve as a hindrance to the formation of ice.

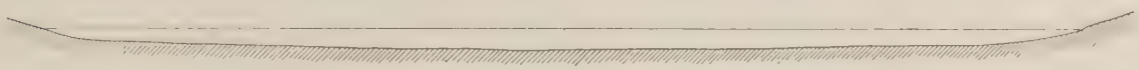


Fig. 197. North. 28.50 29.70 25.30 South.
Breadth = 1,498 m. Scale = 1 : 10,000.

The third line of soundings stretches from Camp CXLII on the northern shore to a cape on the southern shore bearing S. 10° W. The profile shows that the lake is very regular and trough-shaped, being in fact a latitudinal valley filled with water. Both shores here are destitute of flat beaches, but descend pretty steeply to the water's edge, and then go down equally steeply to the great depths in the lake. On the southern shore there is a big gravelly scree, with balghun bushes growing on it. On the opposite side of the lake our camp stood on a tiny expansion of the relatively level strip of shore, a part which some time or other had served as an abrasion terrace. The three soundings which I took here measured 28.5, 29.7 and 25.3 m. (see fig. 197).

Upon a comparison of these three lines of soundings the thing that first arrests attention is the remarkable evenness of the deepest trough at the bottom of the lake. The three maximum depths are 30.00, 29.36, and 29.70 m. This proves that there is at the bottom of the lake a deep gully corresponding to the energetically eroded bed of a river, but both broader and leveller. In the case of the third profile, taken where the lake is only 1 1/2 km. across, the levelness holds good also of the transverse lines, the difference of depth in the middle two-thirds of the breadth being only about 3 m.

On the 4th December we travelled along the eastern side of the mountain-spur that is impassable for camels and can only be got over with difficulty by laden mules and horses. The weather however came to our assistance. During the past night the temperature had dropped to — 20°; the ice ground together and rumbled, showing that it was freezing sharp, and every now and again we heard reports like rifle-shots when gaps and crevices were being split open in the newly formed ice. In the morning we found, that the thin sheets of the day preceding were considerably thicker and that the spaces which were then open water, the spaces which had allowed us to measure the third line of soundings, were covered with a thin coating of ice.

Below the difficult rocky promontory, where the water was recently open, the ice was now 3 cm. thick, and would only just bear the weight of a man. Close at the foot of the rock there was however still a narrow ribbon of open water, caused by the springs which break out at the water's edge; but this we could easily avoid,

Fig. 198. FROZEN PARTS OF THE TSO-NGOMBO.

for we had only to wait one or two days until the ice grew strong enough to bear the weight of the camels.

The distance to Camp CXLIII, at the foot of the rocky promontory, was only a couple of kilometers. The shore retained the same character as heretofore, being

for the most part steep, though there were also two or three places in which it formed level expansions with soft ground, where grass and bushes were growing. The dry wood of the last-named was extraordinarily plentiful all the way and consisted sometimes of logs of massive proportions. So far as we were able to see, the

Fig. 199. FROZEN PARTS OF THE TSO-NGOMBO.

southern shore was at this part broader than the opposite northern shore, and bore a larger number of bushes; the reason of this may be in part that they are less interfered with by passing caravans, which keep to the north side. The lake still continued to be very narrow, the breadth being little more than a kilometer. It was

now covered throughout with a thin sheet of ice, except at intervals, where an open »lane» betrayed the presence of springs underneath. The panorama which unfolded itself on the south side of the lake was in truth magnificent and imposing. Directly opposite to us there rose as it were from the water's edge the bifurcation of a mountain-spur, which, as we saw it foreshortened, had the appearance of a column or pyramid, separating two large and strongly defined glen outlets. Each debouches upon a broad flat beach, plentifully studded with bushes. Pretty high up in each of these glens we saw patches of white; there were without doubt springs near them. At the head of the glens were mountains with a slight sprinkling of snow.

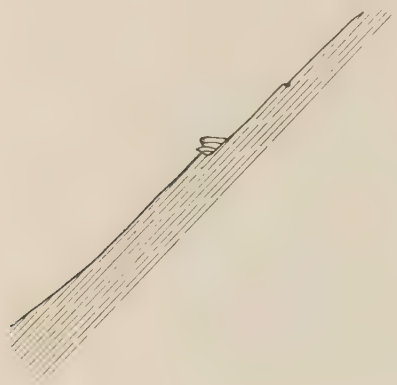


Fig. 200.

On the east of the impeding promontory the flat beach is only a couple of meters broad, but possesses the usual characteristic earthen rampart, formed by the ice. Upon investigation this rocky obstacle proved to be absolutely impassable for camels. A makeshift »path», which runs along it at only a couple of meters above the level of the water, was equally impassable; it could only be used by the agile and sure-footed sheep, by yaks, and by men on foot. This path is regarded, and with justice, as being more difficult than the road which runs along the face of the cliffs higher up. Briefly this latter climbs up from the camp by an endless number of short, steep, abrupt zigzags until it reaches the top. In several places the track rests on small pillars and walls, made up of flat slabs and pieces of timber, and these are too frequently placed on slippery, sloping ground to be at all safe; such fragile and precarious structures would under no circumstances bear the weight of a heavy and clumsy beast like the camel. Where the acclivity is too steep or the nature of the mountain side does not provide sufficient space for zigzags the path runs straight up like stairs, the »treads» being high and difficult even for a man on foot. After reaching the summit of the cliff, a good 60 m. above the level of the lake, you descend for a short space almost precipitously; and here again it would be impossible to get camels down, even if they were to be let down gradually with ropes. Then however there follows a natural shelf, affording a broad and excellent track, with loose gravel; but it soon gives place again to bare rock. The schists dipped here 43° towards the S. 60° W., and the severed heads of the outcropping strata form a level cornice or hollow track in the way shown in the accompanying profile (fig. 200). This path has moreover been mended with slabs of stone; nevertheless it is dangerous for all other animals except yaks and sheep. The heads of the strata are generally so narrow that the slabs when laid upon them hang over on both sides, and a single slip would be enough to send you to your doom at the bottom of the precipice. The photograph of this path shown on Pl. 51 was taken from the lake at the moment when our yak caravan was travelling along it. It is a perilous path for even those sure-footed creatures owing to their habit of pushing forward in a clump and trying to march two or three abreast. For this

Ljustr. A. B. Lagrelius & Westphal.

CROSSING ON THE ICE ROUND THE DIFFICULT PROMONTORY.

reason the Tibetans drive them over this dangerous piece of road one by one; but even then some of them prefer, as the photograph shows, to pick their way amongst the broken rocks above the actual track. This issues finally upon the gravelly scree at the mouth of an eroded watercourse, and then descends abruptly to the lake-shore on the other side of the rocky promontory.

Fig. 201.

At the new camp the profile of the shore was as shown in the accompanying illustration (fig. 201); *b* indicates the highest of the strand-terraces visible from that side; it forms a projecting ledge built of pebbles from the gravel-and-shingle and sand, cemented together into a compact mass as hard as stone. The upper edge of the ledge is 11.5 m. above the existing level of the water, and is thus younger than the beach-line which I measured and described before. That this gravel-and-shingle ledge can be nothing except an old beach-line is clear from its horizontal position, and the reason it projects in the way shown in the illustration is that it has been undermined by the action of the waves and of the ice, of which action we had already observed several instances at the existing lake-level. On the adjacent hard rock no such traces are visible, the cause being, I have no doubt, the relatively rapid decay of the schists. On the same illustration *a* indicates the characteristic strand-rampart formed by ice-pressure, being so steep on its outer side that it was as much as ever we could do to climb over it. At this particular spot it was 3.06 m. above the lake, though in other places it is a little higher. Its height above the interior narrow strip of shore (*c*) was 57 cm. On its outer side too it possessed a very narrow strip of level ground close to the edge of the ice, consisting as usual of sand, mud, and ooze, and the differences in the thickness of its layers shows that it is the result of ice-pressure applied over several years. In places there is a thin dark layer of rotting Algæ, with mollusc-shells intermingled with them. On Plate 49 a section of this rampart may be seen.

In the neighbourhood of Camp CXLIII the lake on the morning of December 4th was frozen in the manner shown in the accompanying sketch (Pl. 50). Here again the open reaches were found principally along the southern shore, their cause being as before the presence of springs; for were there none, that part of the lake which lies during the major portion of the day under the shadow of the lofty mountains on the southern shore would become frozen sooner than those parts which lie exposed to the sun on the north. The ice in the bay near our camp was at 6 p. m. 9.7 cm. thick, and at the thinnest place just off the promontory it had a thickness of 5.2

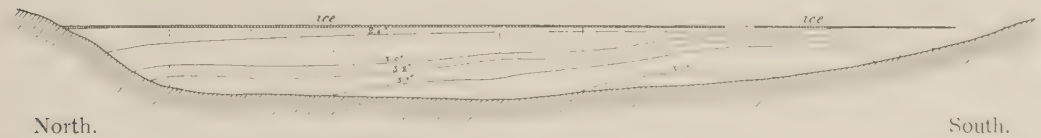
cm. It was as bright and transparent as glass and entirely without air-bubbles. To walk on it was like walking on a glittering sheet of water; we saw the dark-backed fish darting in and out amongst the Algæ underneath our feet. By noon on the following day the thickness of the ice at the two points mentioned had increased to 11.8 and 7.6 cm. respectively.

Fig. 202. A VIEW FROM THE DIFFICULT ROAD.

On the next day, December 5th, I took a series of soundings across the lake, proceeding from Camp CXLIII as far as the ice would allow me to go. The number of soundings was eight, and they were taken at equal intervals along a distance of 1375 m.; the depths obtained were as follows: — 3.69, 18.19, 20.00, 20.45, 21.39, 21.55, 20.00 and 17,45. The thickness of the ice proceeding from the shore out towards the middle of the lake was 11.1, 9.9, 7.5 and 3.8 cm., the value 7.5 cm. holding for five of the holes that we hewed. Immediately south of the last hole, where the ice already bent alarmingly under our weight, there came a long strip of open water, about 30 m. across. On the far side of it there was another expanse of ice, which reached all the way to the southern shore. Thus along this measured line the maximum depth amounted to 21.55 m.; and the reason why I consider this to be the maximum depth is that the next sounding after it, the seventh, was only 20 m., while the last amounted to but 17.45 m., thus indicating a distinct rise towards the southern shore. The maximum depth of the lake will coincide pretty nearly with its middle; but the mean depth north of that is greater than the mean depth south of it. This might indeed be inferred from the character of the shores; for, whereas on the north there are steep rocks, on the south the lake is bordered by a fairly level plain overgrown with bushes. Measured in a straight line from north to south the breadth of the lake will not at this part exceed 1400 m.; but our line of soundings ran towards the S. 40° E., to avoid a couple of holes. Hence from

the last sounding there still remained three or four hundred meters to the southern shore.

In every alternate hole, beginning with the second from the north, I measured the temperature of the water at different depths, namely at four levels in the vertical line, that is to say at 5, at 10, at 15 m., and at the lake bottom. The annexed section (fig. 203) shows the result of these measurements. At each and every one



North. South.

Fig. 203.

3.69	18.19	20.00	20.45	21.39	21.55	20.00	17.45 = depth.
	2.60		2.70		2.82		3.01
	2.95		2.91		3.27		3.48 } degrees Celsius.
	3.21		3.22		3.30		3.60
	3.09		3.29		3.38		3.59

Breadth = 1375 + about 500 m. Horizontal scale = 1 : 10,000. Vertical scale = 1 : 1,000.

of the stations the temperature rose at each successive depth as we travelled from north to south: thus at 15 m. depth it was 3.21°, 3.22°, 3 30°, and 3.60°. Each isotherm shows therefore an upward curve, the vertex of which came immediately underneath the long lane of open water, though this by no means coincides with the greatest depth of the lake, but lies, I dare say, over a depth of 14 to 15 m. At each of the temperature stations the temperature increased uniformly towards the bottom; though there was a slight departure from uniformity observable at the first, where the temperatures read 2.60°, 2.95°, 3.21° and 3.09°. This irregularity may have been caused by chance currents, which must of course exist in a lake at the bottom of which such a relatively large number of warm springs break out. Along the northern side of the lake the water was clearly flowing west, at any rate it was doing so just underneath the ice, as was evident from the direction of the stalks of the vegetation that were frozen fast in the under side of the ice or hung down into the water; they all pointed (see fig. 204) in that direction. And indeed it must of necessity be so, for the Tso-ngombo empties itself through a sound into the Pang-gong-tso; nevertheless the movement of current indicated by the vegetation is, I have no doubt, a local phenomenon occasioned by springs. At the first temperature station we found a warmer layer of water 3.21° between two somewhat colder layers, namely 2.95° and 3,09°. Upon comparing this station with the last one, we see that, whereas the temperature 3.10° occurs in the former at a depth of 18 m., in the latter it is found at 6 m. depth. Anyway the arrangement of the isotherms makes it conceivable that warm springs issue at the bottom of the lake precisely under the open lane near the middle. South of that the isotherms ought to dip down again, in the way shown in the sketch, towards the subaqueous slope of the southern shore.

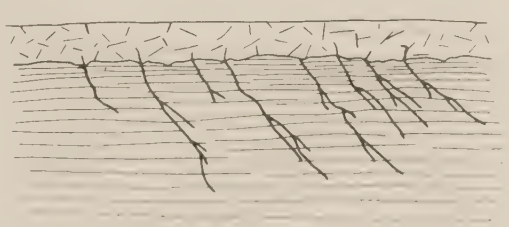


Fig. 204.

The profile shows also the varying thickness of the ice-sheet: it is seen to be thickest under the northern shore and thins out towards the edge of the open lane. Beyond it comes another sheet of ice, probably thin, which in some places reaches all the way to the southern shore; but just in the direction of the line of sounding it is interrupted by a small open belt of water quite close to the shore, and it too is no doubt caused by springs. A single temperature profile like this is however of no great value; all it does is to show up certain local phenomena, and to prove that the irregularity in the formation of the ice is in great part caused by springs. It would be of much greater interest to possess the profiles of a great number of lines across the lake, both in winter and in summer. It is only upon the basis of such a supply of data that we should be able to deduce reliable and illustrative conclusions with regard to the currents and the temperature.

Fig. 205. ON THE WESTERN SIDE OF THE PROMONTORY OF DECEMBER 6.

On the 6th December we travelled to the end of the Tso-ngombo. During the night the ice had grown still thicker, and when we started it was 9.9 cm. thick at the point where the day before we measured a thickness of 7.6 cm. Consequently it easily bore our camels, although cracks showed here and there in its bright mirror. The name given to the impeding promontory by our Tibetans was Gardang, a name which I do not find on the big English map. The morning was still and warm, but before we had gone very far a strong wind sprang up and soon grew into half a gale, the dust and sand being whirled up in clouds. The shore still consisted of an endless number of rocky headlands and capes, the terminations of the spurs and ramifications of the northern range, parted by bays, some small, some large, with regularly curved outlines and usually level, soft, earthy ground, on which grass and bushes were growing, although the latter thrive best on the stony hill-sides. First we passed, making a wide circuit round it, the blunted cape, of which the Gardang headland forms a part, and farther on passed also a pointed promontory.

LOOKING EAST FROM THE BROAD PENINSULA.

Ljustr. A. B. Lagrelius & Westphal.

ON THIN ICE; TSO-NGOMBO.

Between the two lies a wide, sweeping bay, upon which a larger glen opens out, with a conspicuous summit at the head of it. In the N. 72° W. we caught glimpses of a snowy crest, with one or two powerfully modelled pyramidal peaks.

The pointed promontory offered rather a difficult passage: we had to lead the camels one by one first up the steep, slippery rocky slope, strewn with pieces of schist, and then down again just as steeply, while the men carried on their backs the most valuable of my boxes. The ice round this cape was not strong enough to allow us to use it in the same way as we did the ice at Gardang. The part of the lake lying south of the big bay was open, and under the impact of the hard wind the waves were running high. It was only in the innermost part of the bay that there was a narrow ribbon of ice, though quite close to the shore the lake was kept open by springs. In the eastern part of the large bay in which the lake is narrow, the ice formed as it were a bridge diagonally across it and appeared to be fastened to the southern shore.

Fig. 206. EASTERN TSO-NGOMBO.

Beyond the pointed promontory lay another large bay of almost precisely the same appearance as the first; but it was more troublesome to march round owing to the great number of small rocky spurs, so that the caravan made painfully slow progress. Upon reaching the west side of this bay we turned almost due south, and then had immediately on our right flatter slopes, strewn with a thin and rather scattered coating of drift-sand, which here and there rose into dunes. We were witnesses of how the sand is brought thither by the wind, and settles in crevices and gullies to the leeward. Owing to the configuration of the surface these dunes get no opportunity to reach a greater height or size, and the wind keeps them pretty constantly at the same level.

In the western part of the bay, which was protected against the wind and the waves, the ice was thick and strong; but outside the cape on the west side of the bay there was open water all the way to the point at which the river issues from the Tso-ngombo. But some Tibetans whom we met told us, that even this

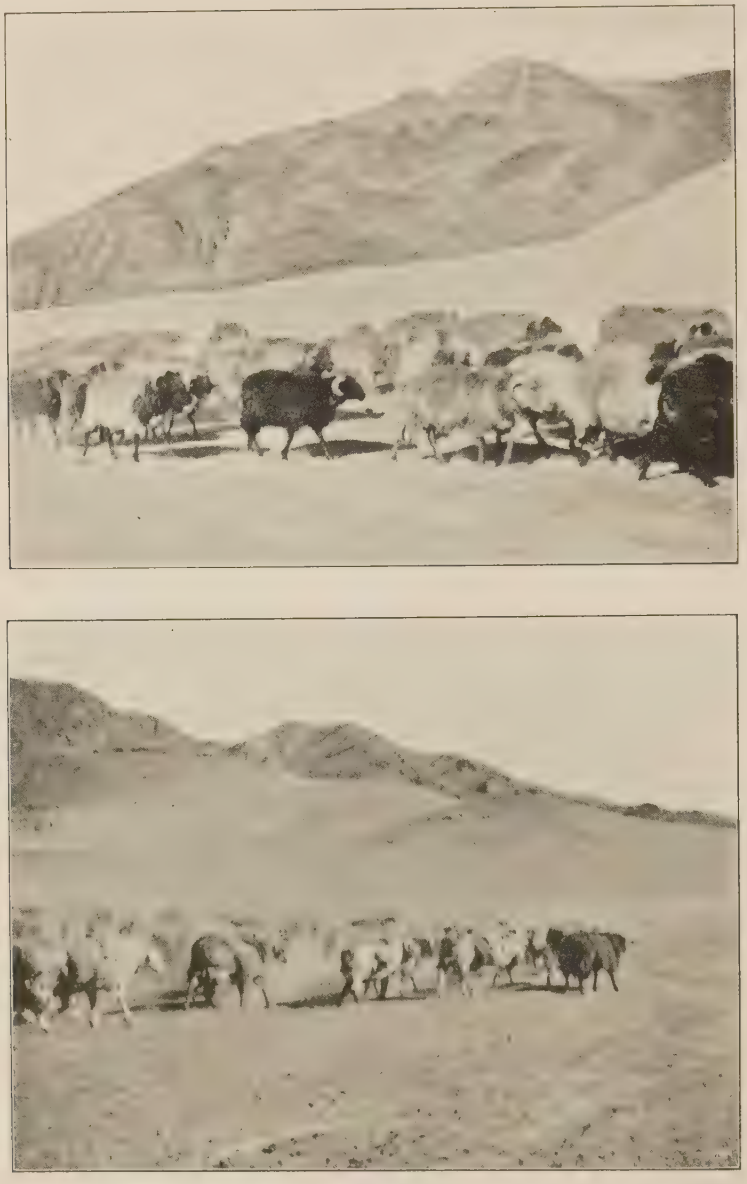


Fig. 207. A SHEEP-CARAVAN ON THE SHORE OF TSO-NGOMBO.

part of the lake had been covered with a thin sheet of ice the day before, though nothing like strong enough to withstand the hard wind which was then blowing. And their statement was rendered probable by our seeing bands of broken ice on the shores and capes, showing how the wind had blown it from the west. In one

or two places we were witnesses of how the drifting ice, under the impulse of the wind, ploughed up the soft material of the beach, an illustration of the way in which the strand-ramparts are formed which I have described above. As I thus travelled

Fig. 208. A SHEEP-CARAVAN ON THE SHORE OF TSO-NGOMBO.

Fig. 209. AT THE WESTERN END OF TSO-NGOMBO.

alongside the Tso-ngombo just during the days when it was freezing over, I had an opportunity to observe how the formation of the ice advanced from east to west; or in other words, how the easternmost basin froze first, then those successively that followed next after it, yet in such wise that the narrow and sheltered parts of

the lake froze before the opener and more exposed parts. This order of procedure certainly did not depend upon temperature relations peculiar to that winter, but is a matter of annual occurrence. It depends upon the circumstance that the climate does as a matter of fact grow milder towards the west. In the east the winter is of the severe, continental, Tibetan type; in the west the cold is of a more moderate character.

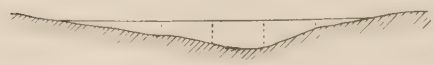


Fig. 210.

Leaving behind us the last spur of the mountains, at the foot of which a true dune was heaped up, we directed our course towards the south-west, and passed on our left hand a flat, blunted cape, on which soft, luxuriant grass was growing on tiny sand-hills, and a troop of 30 horses were grazing it. The lake was by this contracting, and finally it came entirely to an end. Out of the tapering cove at its western extremity flows the river, called by our guides Odschi-tsonjak. As it happened, in consequence of the wind there was a surface current running backwards towards the Tso-ngombo; but the Algæ at the bottom of the river proved that there was a gentle under-current flowing towards the Panggong-tso. A short distance below the beginning of the river we pitched Camp CXLIV; on the slopes of the mountains opposite numerous bushes were growing. There were wild-duck; but we saw no fish in this section of the river, possibly because of its nearness to the salt water of the Panggong-tso.

Fig. 211. LOOKING DOWNWARDS FROM CAMP CXLIV.

On 8th December I measured the volume of the river at this point, the result being the profile shown herewith (see fig. 210). The breadth was 11.2 m.; the mean depth, 0.475 m.; the maximum depth, 0.940 m.; the mean velocity, 0.591; and the volume, 3.14 cub.m. per second. This inconsiderable volume of little more than 3 cub.m. will, I dare say, remain pretty constant during the winter, and may be regarded as the quantity of water which the freshwater lakes receive during the

winter from the Tsanger-schar and other rivers plus what they derive from the innumerable springs which issue on its banks or in the bottom of the lake. Our Tibetans indeed asserted that the river in this section remains pretty constant all the year round, the only exception being a slight rise after rain. How far that is true can of course only be determined after continuous investigations on the spot. On the one hand we have to assume, that the outflow is considerably greater in the summer than in the winter, in consequence of the rainfall and the melting of the snows; but on the other hand the evaporation should be far more active in the summer than in the winter, when it is prevented by the ice. At the spot where we measured the river, we observed marks on the banks, which told us that not very

Fig. 212. UPWARDS FROM CAMP CXLIV.

long before the river had been 44 cm. higher than it was then, which would mean a volume three times as great as that which we measured. At that time the difference of level between the Tso-ngombo and the Panggong-tso could not amount to many centimeters. Farther down the erosive energy of the stream was more active. It looked as if the Panggong-tso were shrinking at a relatively more rapid rate than the Tso-ngombo, and thus accentuating the difference of level between the two lakes, with the consequence that the erosion in this section of the river will move backwards up it owing to the fall being increased in its lower part. In the upper part of the same section the fall is quite insignificant, and the river is deep and broad. It is however eating its way in deeper in consequence of the constant fall of level in the lakes occasioned by the alteration of climate, a fact of which we noticed many proofs in the interior of Tibet, as also in the old strand-terraces of the Tso-ngombo; and at this camp, No. CXLIV, we soon discovered beach-lines at a very much higher level. If we start from the fact, that both lakes are shrinking, we can easily conceive the following course of events as happening. In the begin-

ning of December the Tso-ngombo discharges 3 cub.m. into the Panggong-tso; this lake probably does not freeze, at least not the whole of it. Consequently the evaporation from the latter lake is more active in winter than it is from the former. This causes a difference of level, and that again intensifies the erosive energy of the river.

Fig. 213. TERRACES ON THE SHORE OF TSO-NGOMBO.

There is a constant inflow into the upper lake, but the water is passed on to the lower, the Panggong-tso. There is nothing to show that the two lakes, say in consequence of the contribution from the Tso-ngombo being at any season arrested, ever happen to lie at the same level, or that there can be a retrogressive current from

the Panggong-tso to the Tso-ngombo. The first-named is always the final reservoir and always the lower, and the freshwater lake has always the larger drainage-area. In any case the subsidence takes place so slowly that the erosion may very easily keep pace with it. If however the general desiccation of the climate is continued in this part of Tibet also, it is conceivable that some day the inflow into the Tso-ngombo will be so infinitesimally small that it will be counterbalanced by the evaporation, so that the lake will then be unable any longer to discharge its contents. Not until that happens will the two lakes become disconnected one from the other, and the consequence of this will be that the Panggong-tso, its constant inflow being cut off, will drop even more rapidly than before, while the Tso-ngombo will in the meantime become gradually changed into a salt-water lake. This fate has already overtaken the Panggong-tso, and when we reached its western end, we found there a very low sill or threshold, over which the lake formerly possessed an outflow to the Indus.

Fig. 214. VERTICAL SECTION OF THE TERRACED SLOPE AT CAMP CXLIV. THE FIGURES INDICATE THE DISTANCES BETWEEN THE STATIONS; HORIZONTAL AND VERTICAL SCALE = 1 : 1600.

Nor can it be very long since both lakes were connected together and formed one exceptionally long lake. The isthmus between them, which is now pierced by the river, consists exclusively of flat, level land; the northern and southern mountains leave there a gap between them which is no narrower than in many other constricted parts of the Tso-ngombo. It would require a rise of only a few meters in both lakes for the greater part of this lowland to be inundated; and we have only to call to mind the beach-line at 19.5 m. above the Tso-ngombo to see clearly, that at the time when the surface was at that level the isthmus between the two lakes must certainly have been under water. For if we suppose that the two lakes were even then separate, we should expect to find the connecting stream flowing in a proportionally deep channel, with older beach-lines at the sides; but such is not the case. The river flows on the surface and is bordered, especially on the north, by level, low-lying land.

On the slope built up of a closely cemented mass of gravel-and-shingle and pebbles that went up south of Camp CXLIV we observed three very distinct strand-terraces, though none of them corresponds to the terrace 19.5 m. above the Tso-ngombo. They were measured in the same way as the last-named, the levelling-mirror being 1.5 m. above the ground; the figures indicate the distances between

the different stations. The measured line starts at the river-bank and proceeds S. 30° E. The first terrace lies at an altitude of 13 m., the second at 21.5 m., and the third or highest at not less than 54 m. Notwithstanding that it must date from a very distant period, and thus must have been the longest exposed to the atmospheric influences, this last terrace is the most distinct, incomparably better defined than either of the other two lower terraces. It must consequently point to a lengthy period during which the long, united lake was maintained at the same level. The circumstances are an exact repetition of those which we found at the Lakor-tso, where the highest terraces were also the most distinctly marked. The absence in this place of the 19.5 m. terrace of the Tso-ngombo, and the absence

Fig. 215. MOUNTAIN SUMMIT NORTH OF CAMP CXLIV.

beside the Tso-ngombo of the three terraces which we measured in this place, are purely fortuitous. If the lake was formerly 54 m. higher than it is now — and why not higher still, although we did not observe any strand-terrace? — then the lake in the course of its steady shrinkage ought to have left behind it a great number of other beach-lines, and these would be developed in varying degrees on the different capes, in consequence partly of the material upon which the waves would expand their force and partly upon the situation of the slopes relatively to the broad, open expanse of the water-surface and the direction of the prevailing wind. When the lake was 54 m. higher than it is now, its area would of course be considerably greater than it is at present, yet not altogether so great as the difference of level would lead one to expect, for the valley is narrow and its slopes steep. But at that time the lake would send out numerous fjords, penetrating relatively deep into the lower parts of the transverse glens in the adjacent mountains, as, for instance, into the glen of Niagzu, into that at Bal, and into many others. In the extreme east a large proportion of the plain of Noh would also be under

water, and in its lowest course the valley of the Tsanger-schar would push out a bay. At the period we are contemplating the Tso-ngombo will have been as much as 85 m. deep, and possibly deeper. If now we assume, that the constant shrinkage, which is revealed by the strand-ramparts, continues also in the future, then the stream, in spite of its constantly decreasing volume, will go on excavating its bed deeper in the isthmus between the two lakes. In the eastern part of the Tso-ngombo we have already noticed several separate basins. Numerous others of a like character would gradually make their appearance in the large lake. Finally they also would disappear, the last of them being a salt lake, which would receive water from the Tsanger-schar when the latter was in flood, the Tsanger-schar

Fig. 216. TIBETAN ENCAMPMENT NORTH OF CAMP CXLIV.

itself making a single continuous river flowing down the valley. After I have described our journey along the northern shore of the Panggong-tso, I propose to return again for a further brief consideration of this interesting and fascinating pair of lakes.

During the three days that we spent at Camp CXLIV the wind blew hard from the west in a series of intermittent gales, bringing with it such vast clouds of dust and sand that at times it made the day as dim as twilight. The great quantities of material which are in this way carried into the western part of the Tso-ngombo from the isthmus and the adjacent mountains help in some respects to render its basin shallow. These gales retarded the freezing of the lake, and so long as we remained there, the western part of the lake remained open. During temporary lulls that occurred on the 7th and 8th December we seized the opportunity to take soundings in the western part of the Tso-ngombo.

The series of soundings which I then proceeded to take were made along a zigzag line in the following way: from the outfall (A) of the river S. 45° E. to a

point B on the southern shore (see fig. 217); from B, N. 32° E. to a point C on the northern shore, that is the extremity of the broad, grassy cape near the sand-dunes; from C, S. 82° E. to a prominent cape D on the southern shore; and finally from D, N. 65° E. to the point E. on the northern shore, that is to say the pointed rocky promontory between the two big bays already mentioned. Thus the series as a whole is divided into four sections (see figs. 217—220). From these it results that the greatest depth in the line farthest west was 15.0 m., in the second

Fig. 217. 11.61 15.00 14.50 10.52 = depth.
Horizontal scale = 1 : 20,000. Vertical scale = 1 : 10,000.

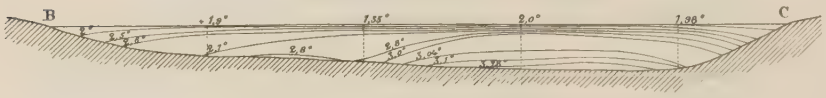


Fig. 218. 17.25 21.37 26.54 25.20 = depth.

	1.90	1.35	2.00	1.98
	2.61	2.71	3.00	2.70
	2.62	2.77	3.05	2.99
	2.76	2.78	3.04	3.03
	2.76	2.81	3.10	3.03
			3.28	3.18

degrees Celsius.

Horizontal scale = 1 : 20,000. Vertical scale = 1 : 4,000.

Fig. 219. 28.26 28.52 29.16 23.52
Horizontal scale = 1 : 20,000. Vertical scale = 1 : 10,000.

Fig. 220. 29.38 31.76 31.13 26.79 26.30 = depth.
Horizontal scale = 1 : 20,000. Vertical scale = 1 : 10,000.

26.54 m., in the third 29.16 m., and in the fourth 31.76 m. In other words, the depth increases towards the last until we reach the deepest basin, which in the light of my experience will not essentially exceed 31.76 m. in depth. The reason why the lake grows shallower towards the west with the great regularity shown by the profiles is to some extent the gradual filling up of the basin, the work of the west wind. The first, third, and fourth profiles illustrate what I have said above as to the lake-basin and the uniform levelness of the bottom of the lake as a whole. The second profile is on the other hand somewhat irregular; in it we have the unexpected circumstance of the smallest depths lying under the steep cliffs on the south side of the lake, while the greatest depths lie just under the flat, sandy strip of shore on the north. One would have expected that the bottom would slope gently and

uniformly from the latter side to a maximum depth under the cliffs on the south side of the lake; but as a matter of fact there exists a sharp projecting angle at the peninsula mentioned, which thus resembles a terrace (fig. 221), with a steep face, and it is at its foot that the greatest depth is found.

The bottom of the westernmost part of the lake is throughout overgrown with luxuriant Algæ, which, when seen from above, wear a most picturesque appearance, looking like coniferous forests. Some of them reach up to within a meter of the surface, making the lake appear quite shallow, so that I was surprised to find the lead dropping several meters down amongst their greenery. In the extreme west, where the lake contracts to a funnel shape before yielding place to the river, all the Algæ point towards the west, clearly showing that the current exercises a suction action in that direction.

Fig. 221.

Along line No. 2 in the above sketch I also made observations of temperature at various depths, that is at every fifth meter, as I did before. The results are given in fig. 218. The surface water had a temperature of at least 1.35° and at most 2°; this latter reading occurred above the greatest depth of the lake, where also the bottom temperature was 3.28°. Along the same line of soundings, that is the second counting from the northern shore, the temperature was everywhere higher at the corresponding level in the adjacent layers of water. Consequently at that place the isotherms curve sharply upwards. A comparison between this profile and the preceding (see fig. 203) shows a great difference in the direction of the temperature curves. In the former they indicate beyond a doubt the presence of springs at the bottom, as was also evident from the fact that the lake there at a depth of 17.45 m. had warmer water than it had at a depth of 26.54 m. in the latter locality. In the former place the lake was frozen right across; in the latter it was quite open, a consequence of its greater depth as also of the violent wind of the preceding few days, the thin one-night-old ice being unable to hold its ground against it. During the lull of some hours which occurred on the 8th December a thin coating of ice did form over certain parts of the lake, but it was broken up again next day by the wind. Off the pointed promontory on the north side of the lake (E. on fig. 220) there was formed on the 7th Dec. a belt of ice 400 m. across. I have no doubt that in the end of December the Tso-ngombo can be crossed in every and any direction on the ice, and by hewing holes in it, it would be possible to take a number of particularly reliable and well defined soundings, and so obtain a first-rate map of the bottom of the lake.

The cause of the upper part of the river not being frozen was partly the current, partly the fact that the water upon entering it had a temperature of + 1 1/2°. It was not until it had sufficiently cooled that it froze, and then the ice sometimes reached right across. In the upper part there were only narrow ribbons of ice in an occasional sheltered corner; the fact of these hanging 2 1/2 cm. above the surface of the lake (see fig. 222) does not necessarily prove that the lake had dropped to that extent, because these ice-fringes increase with the help of the waves that the wind drives against them.

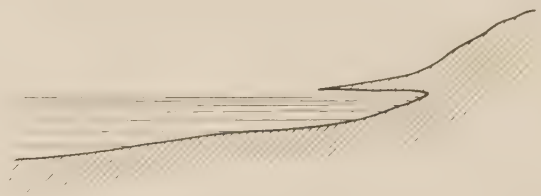


Fig. 222.

The measurement of the river alluded to above was made a few hundred meters above the camp, clearly corresponding to the locality marked on the large English map with the word »Ford». It is there that the road from the northern shore of the Tso-ngombo crosses the river in order to continue along the southern shore of the Panggong-tso *via* the village of Mun. On the map in question the river bears no name. It is there that the big, broad glen of Niagzu debouches, and in its outlet, on the right side, the map places the ruins of the fort of Khurnak; near these on the occasion of my visit stood a couple of Tibetan tents. I never heard the name Nyak-tso, which the map applies to the whole of the freshwater lake; the only name I heard was Tso-ngombo, or the Blue Lake. Everybody on the other hand knew the name Niagzu, and possibly Nyak-tso has been confounded with that name.

THE RIVER AT CAMP CXLIV.

CHAPTER XX.

THE EASTERN PANGGONG-TSO.

On the 10th December we began our march along the northern shore of the long Panggong-tso. With the view of exploring the river I paddled down it in the skiff, and intended to continue the trip by boat along the lake, but in this I was as usual prevented by the wind. The river hugs closely the southern mountains the whole way; hence we paddled in the shade and it was cold. The banks consist of level, or very slightly undulating, grassy, sandy ground. We passed on the left bank first a frozen spring, then an unfrozen one. Below the latter was the beginning of a long strip of alluvium, which contracts the river, and as this is also shallow, the current is quickened. It was here that we measured the spot in which the maximum depth was 0.94 m., and here too that the road crosses the river. A drop of only one meter in the level of the lake would cause the Tso-ngombo to be entirely cut off from the lower lake. The sounding 0.94 m. is the shallowest place in the deep bed of the stream; but, as the velocity there is greatest, erosion is consequently most active at that spot, and it is uninterruptedly operative excavating the bed deeper. Pl. 54 shows the configuration of the river-bank at Camp CXLIV. At the spot where we measured the river the banks have a very different appearance, being far more energetically excavated, not indeed very high, barely a meter, but they are vertical, and bear distinctive marks of a water-level 0.44 m. higher than the existing level. Although the Tibetans tried to make me believe, that the river always maintains the same level, this water-mark proves conclusively that it does sometimes reach a higher level. At first it did occur to me, that the lake might exercise a moderating effect upon the outgoing volume in the same way as the Baghrasch-köl does upon the Kontsche-darja, by distributing it evenly throughout the year. Yet such is evidently not the case. The copious inflow in the summer must cause the lake to swell, giving rise to a considerable augmentation of volume in the outgoing stream in the late summer or autumn. At the time of our visit the river carried, as we have seen, a volume of 3.14 cub.m. and was 11 m. broad. When the water rises 0.44 m. higher, the breadth increases to 22.5 m., and the velocity will then of course be considerably greater (fig. 223). A provisional calculation suggests that the volume will then be about 10 cub.m. In consequence

of the relatively small area of the upper lake — in fact it may, strictly speaking, be regarded as an expansion of the river-bed — this high water would seem to go past rather rapidly. By the beginning of December the outgoing volume has already diminished to one-third, and would possibly decrease still further during the course of the winter, unless, as I have already suggested, this volume of 3 cub.m is to be regarded as the result of the contribution of the perpetual springs superadded to the volume of the Tsanger-schar, which also is derived in the first place almost entirely from springs, and consequently will remain pretty constant during the winter.

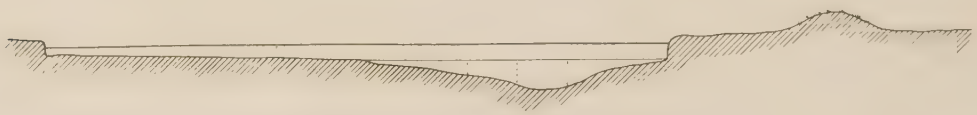


Fig. 223. 0.26 0.52 0.83 0.94 0.30 = depth.

The bed of the river is pretty straight; at all events its windings are inconsiderable. It is only on the left bank that there exist the beginnings, long and narrow, of alluvial formations. Those that lie below the spring I have mentioned are the biggest and would appear to be in a measure produced by the spring-water, which flows pretty abundantly. This water is, it is true, quite clear; but it may possibly give rise to a whirlpool, which forces the solid material to settle to the bottom. At the time of our visit the river-water was as bright as crystal, and contained no trace of either dust or mud. The alluvial formations point therefore to an enhanced activity at certain times.

Along the left bank is a narrow strip of grass, which runs rapidly up towards the foot of the gravelly screes. A little way back from the right bank is a low, rounded ridge, likewise grassed over; this may evidently be regarded as an older strand-terrace, now in great part destroyed. Lower down the river widens, and a promontory from the southern mountains forces it to form a **S**-shaped bend: at this spot it was covered with a sheet of ice one night old and as thin as paper. Above that we saw no ice except in the more sheltered bends; but below that point the ice increased in area, and in some places the river was entirely sheeted with a film 1 to 2 mm. thick, which seriously impeded our progress. Next the right bank was a crescentic alluvial deposit of pretty big extent, almost entirely under water; this was at that time covered with a sheet of ice as much as 2 dm. thick. Along the southern bank too there was a belt of ice sufficiently strong to bear both us and the skiff. Here in one of the deeper parts we saw fish swimming amongst the Algæ. In two places the big alluvial deposit rose into islands, with steep sides and grass on the top. These originally formed part of the bank, but had been rent away from it by an exceptionally large flood, and are now independent of it. The erosion terraces still continued to be powerfully developed. We next passed three more springs on the left bank, which had given rise to large cones of ice, of the same kind as those at the springs of Temirlik, only a good deal smaller.

After making a bend to the north, in which the water was open for a short distance, the river became entirely frozen over. At the same time it grew broader,

400 to 500 m., expanding trumpet-fashion until it was more like a bay of the Panggong-tso. The ice in the middle of the current was however thin and would nowhere bear right across. Just before it enters the Panggong-tso, two tongues of alluvium jut out into the river, both from the right. They point towards the east, that is to say up-stream, against the current. This direction is of course imparted to them not only by the prevailing wind, but also by the waves to which it gives rise, and which run counter to the current and affect especially the surface water. Near the lower of these two capes we found a small round hole in the ice, made either by an eddy or by a spring at the bottom. The mouth of the river put me strongly in mind of the embouchure of the Satschu-tsangpo into the Selling-tso. In both cases there is a regular channel, a broad bed widening out towards the lake and terminating in an open estuary.

All day the wind blew hard from the west, so that we were all the more surprised to find a considerable expanse of ice stretching from the mouth of the river for a long way out into the lake. In fact we could only just discern its greenish blue water as a narrow ribbon beyond the white edge of the ice. This ice-sheet at the eastern end of the Panggong-tso was triangular in shape, its blunted apex entering the river-mouth, where it was directly connected with the river-ice. This was the only ice we saw on this lake, except for one or two narrow strips which we passed that same day close to the northern shore. The ice-sheet did not however present a smooth level surface, but was rugged, consisting for the most part of pounded ice, which the waves had gradually driven into this bay from the west, and there packed up in circular belts. How this ice happened to originate in that part of the lake which is most exposed to the wind is not difficult to explain. It is fresh water out of the Tso-ngombo which has spread out over the salt water of the Panggong-tso and then frozen during the still cold nights. We found that the water which was being blown into the river had a temperature of $1\,^1/_2°$ to 2°, and it did not therefore freeze until it arrived at the middle reaches of the river, where it was cooled in the shallow bed. In the lowest part of the channel, where the stream is twenty to thirty times broader than it is higher up, and where the depth increases until in the river-mouth it amounts to 5 or 6 m., the current was so little noticeable that it offered no impediment to the frost. The temperature in the eastern part of the Panggong-tso was 0.9°, and consequently it too presented no hindrance to the freezing of the layers of fresh water resting upon it. Accordingly the latter freezes in narrow belts, which however are broken up the following day and the pieces driven against the edges of the nearest resistant ice. In this way the triangular ice-sheet will go on increasing during the course of the winter, spreading out farther over the lake, though I do not suppose that it advances to any very great distance unless the wind drops for a sufficiently long period to allow of the ice acquiring a certain power of resistance.

From the lower cape we rode towards the north-west, keeping along the shore. The ground next the lake consisted of barren schor, on which older, curved beach-lines were discernible, formed by the wave-beat of the Panggong-tso. A little distance from the shore is a stretch of dunes, about a meter high and overgrown with grass. The beach is crossed at that point by a dry river-bed coming from the

N. 24° E., broad and winding, but not very deeply incised. In its bottom were several belts of ice and frozen pools; it bore evidences however of carrying at times a very large volume of water. It rises in the big glen of Niagzu to the north, and possesses an extensive drainage-area. After rain the river swells to a considerable stream, and transports quantities of mud out into the lake. So far as I could see, no branch of this river joins the arm connecting the Tso-ngombo with the Pang-gong-tso. The Tibetans who were then encamped beside the ruins of Khurnak, draw such water as they need in winter from the bed of the Niagzu river.

Fig. 224. ON THE SHORE OF A BAY OF PANGGONG-TSO.

After that we passed two frozen springs, and a third at the foot of the first cape that we doubled; but this was not frozen and its water had a temperature of 6.7°. Thus to the eastern part of the lake a not inconsiderable supply of water is contributed directly by springs, and it spreads itself out on the top of the salt water. By the next cape the northern wing of the triangular ice-sheet had thinned out to a point; though in the next bay we came to there was a thin film of ice, which undulated with the movement of the waves, the lake being then in commotion. We found similar thin films of ice in the next following bays; but the farther we advanced towards the west the smaller they grew, the water becoming at the same time salter, and at length the ice came to an end altogether. From one cape on the lee side a long narrow tongue of ice jutted out towards the north-east, a little distance out from the shore, and once or twice we observed patches of ice floating freely on the lake. The effect of these in moderating the violence of the waves was visible a long way to the lee. In a word, the lake is not quite exempt from freezing, but this is confined, at any rate in December, to its extreme eastern part. The salinity is slight: the sp. gr. at Camp CXLV was 1.0105.

The configuration of the shore in the case of the Panggong-tso is the same as in the case of the Tso-ngombo, the only difference being that the mountains which border the former appear to be more massive and more compact, and the spurs they send out higher. Our journey beside the Panggong-tso necessitated our doubling one projecting rocky headland after another, these forming blunted peninsulas with bays between them; and at the base of each of these rocky headlands lies a scree of stones and gravel, which rendered our march difficult and slow. At the inner end of the bays the ground was generally soft and level; it is more frequently tinged with white than the soil beside the Tso-ngombo, saline deposits being of course the cause. We also observed lower shore-marks, a proof that the lake is shrinking; on the other hand the well-defined rampart beside the freshwater lake, which I attribute to the pressure of the ice in spring, was wanting beside this second lake: it was only in the east that we perceived a few rudimentary attempts at such a formation.

The Panggong-tso lies in the continuation of the Tso-ngombo's latitudinal valley, one of the biggest and most accentuated of all the latitudinal valleys that we encountered in the whole of Tibet. In the light of the knowledge that we already possess as to the orography of the country, it is not possible to say with certainty where this great valley begins; but one thing it is pretty safe to say: it does not begin at the lake near Noh, but it stretches, I feel sure, a good long way to the east of that lake, or rather east-south-east. Here on the high plateau it is however less sharply defined and bounded by mountain-chains; anyway the mountains that shut it in are less considerable than those which hem in the two long lakes. On the plateau the valley appears moreover to divide into two more or less parallel valleys, one of which forms a continuation of that in which the lakes are situated, while the other is traversed by the Tsanger-schar. Other latitudinal valleys could, I have no doubt whatever, be found in western Tibet which are just as well defined as this one, and run parallel to it, but what makes this particular valley so noteworthy is the presence of the two long lakes, which so sharply and so distinctly mark its course. In one respect however this valley does appear to distinguish itself from its congeners, and that is in its relatively great depth. As we shall find presently, the Panggong-tso is 48 m. deep, and after its water has disappeared, this valley will be even deeper than all the others. Moreover the circumstance, that from time immemorial the road between Ladak and Tibet has always run beside these lakes, has made this valley better known even to Europeans than all others in western Tibet. There still remains however a good deal to do before we can venture to make safe deductions with regard to these matters. Captain Rawling's map contains some orographical features which appear rather strange. It is probable that here also the same parallelism obtains which governs the systems of the Himalaya and the Kara-korum, a parallelism in which the two lakes also participate.

Along their southern shores runs, as I have said, a path; it appears however to be difficult to travel along it, and, so far as could be judged from the distance, it is impossible for camels. Bushes grow not only on the shores of the bays, but also on the stony capes, and this on both sides of the lake, though on the north

they thin out in a remarkable way. By preference they appear to establish themselves on that side of the rocky, stony promontories on which you would expect that they would find the smallest amount of nourishment and would be most exposed to the wind. As a rule, it may be said, that on these stony slopes the fresh and still living balghun bushes grow down at the bottom, only a few meters above the water; a little higher up they languish and appear to be on the point of perishing; while towards the top of the slope they are withered and dried up, nothing being left except the stumps and knots of old roots and stems, often of considerable size. Owing to the frequency with which this arrangement recurs, it cannot be the result of pure chance. The impression is borne in upon the observer, that the bushes which are now withered died in consequence of the recession and subsidence of the lake, with the result that their roots no longer reach down to the level of the water (fig. 225). Those in the middle zone are on the point of losing this connection; whereas those in the lowest zone are still fresh because they are able to satisfy their need for water. It is also noticeable, that the higher up the bushes are situated, the bigger they are, the explanation, no doubt, being that towards the bottom of the slope these are still so young that they have not yet reached the full period of growth, whereas those towards the top were fully mature and perfectly developed before they withered and died. Thus the vegetation also seems to afford an indirect proof, that the Panggong-tso is subsiding, though this stadium is of comparatively recent date.

Fig. 225.

Here, in this eastern part of the lake, we soon discovered that the salinity is so slight that it is not even inimical to organic life. Wild-duck were quite common on its shores. And there evidently are Algæ; at all events we saw them cast up here and there on the shore. At low places, where the shore-line curves, we found vast quantities of mollusc shells, and they were bigger than any that we had hitherto seen. In one place we observed specimens of the usual Crustaceans. On the other hand we observed no fish; presumably the water is too salt for them. The grass was on the whole bad; further on teresken and other hard scrubby steppe plants occurred.

On those parts of the southern shore which lie more exposed to the west we frequently observed distinct lines, showing where old strand-terraces had been. In one place there were seven such lines one above the other, the highest of which appeared to correspond to that which we last measured.

A blunted cape occasioned us no difficulty in getting past it, because at the foot of the mountain was a steep scree of stones. Everywhere where they reach all the way down to the water's edge, these stones were panoplied as it were with ice, each individual piece being capped or crowned with a thick, white coverlet, and

this arises when the waves beat against the stones, chilled as they are during the night (figs. 226 and 227). Wherever the shore is flat and forms bays, it is often bordered with a narrow fringe of ice lying on the dry ground, and presenting in profile the appearance shown in fig. 228. Its edge is as a rule 19.5 cm. high and is abruptly

Fig. 226.

broken off. It would however be rash to conclude from this, that the lake had dropped to the extent indicated since the narrow strip of ice froze; it is more probable that this ribbon of ice originated as a consequence of the beat of the waves. Nevertheless the diminishing inflow from the Tso-ngombo in autumn and winter will of course

cause the Panggong-tso to drop, and this result will be further accelerated by the evaporation and the shortage in other supplies of water.

Next followed a stretch of open, flat country round a bay; there we passed a little protuberance on our left hand, making a free-standing promontory in the same bay. On another similar mountain-knob a flock of sheep were grazing round an obo. This little littoral plain continued to increase in breadth and formed a blunted peninsula. It sends out a cape towards the south-east, forming the western boundary of the bay just mentioned; near its inner part it too had a narrow ribbon of ice. The plain is crossed by an erosion channel cut $3^1/_2$ m. deep; it issues out of a side-glen coming down from the north. Although it was then dry, one or two patches of ice still remained in the bottom. It is surrounded by numerous balghun bushes and yielded some grazing, although then hard and yellowed. The predominant rocks throughout this locality were green and black schists. The name of the place was Siriap, rendered Suriah on the English map.

Fig. 227.

At last on 11th December the weather was suitable for a trip on the lake, there being only the softest of breezes from the east, though the sky was everywhere covered with heavy clouds; and of the higher reaches of the mountains, in which, to judge from what we saw afterwards, it was then snowing smartly, we saw nothing. On the south the mountains were growing increasingly more massive and more imposing. I am fortunately able to add one or two photographs of them. Our Tibetans called them Manigangri. Snow also fell on the main range on the north side of the valley, as we saw from occasional glimpses of it which we caught through the side-glens.

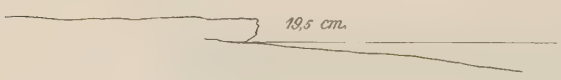


Fig. 228.

I now sent one of my Cossacks, together with a boatman from Lop, to make soundings. From Camp CXLV they steered towards a cape that bore S. 65° W. In the course of the afternoon a keen wind sprang up in the south and soon the lake was white with pursuing waves; but by then my men were safe over on the other side. They then proceeded to travel along it towards the west, while Tschernoff, the Cossack, made a preliminary map of it. At sunset, when they made a fire, we saw their camp bearing S. 7° W. To the results of their trip I shall return later on.

Meanwhile the rest of us also pushed on west, keeping along the shore, which, being flat and soft, was scored by a great many gullies, all serving to carry water out of the transverse glens through the mountains on the north. One of these watercourses is of noteworthy dimensions and terminates in a bay deeply penetrating inland, and sheltered in part against the southerly wind by a projecting peninsula, with two small promontories that jut out north like barbs. The peninsula is built up of crags of green schist, with steep sides. At the foot of the crags was a scree or terrace of gravel-and-shingle and pebbles, the spaces between the larger stones being filled in with sand and fine material. They are as though they had

been stopped up and plugged hard by the water, so that the whole now forms a single compact mass as hard as conglomerate. The upper surface of this terrace was then about 10 m. above the level of the lake. But it has been subsequently undermined by the waves to such an extent that its outer edge has for the most part broken off. Between the rocky wall and what survives of the crumbling ledge, and on the outside of the heaps of fallen material, runs the track, only one meter broad (fig 229). For a caravan of sheep, marching one behind the other in Indian file, the path is passable enough, but for camels it is quite impassable. Fortunately the lake at the base of the scree was so shallow, that we were able to lead our camels round one by one. The temperature of the water was + 1.9°, so that it was considerably warmer than it had been farther east, the difference being undoubtedly due to the greater depth of the lake in this part.

Fig. 229.

We now travelled for a space towards the south-west, the shore being scalloped in the usual way with rocky headlands, parted by bays of regularly curved outline. Upon each of these bays there debouch as a rule one large glen and several smaller ones; and at the head of the larger one we generally saw a more or less conspicuous peak, probably belonging to the main range or one of its more important branches. As in the case of the Tso-ngombo, so here again we were able to distinguish two different kinds of shore formation; one being, like the plain at Siriap, convex towards the lake (fig. 230), a peninsula in fact, while the other is concave, that is to say a bay (fig. 231). The surface of the former is slightly and irregularly undulating and consists mostly of sand; the latter slopes slowly and regularly up towards the foot of the mountains. These flat peninsulas are not however so frequent as the bays, and in the case of the latter the same type recurs so invariably that one might almost imagine them to have been cast in one and the same mould. The southern shore appears to exhibit on the whole the same configuration. It was however practically impossible to map it from the north side of the lake; both perspective

Fig. 230.

Fig. 231.

Fig. 232.

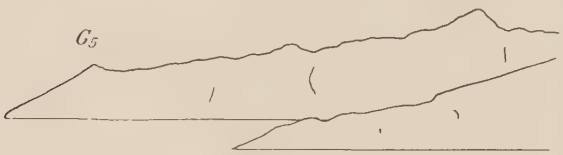


Fig. 233.

and distance were deceptive. All the great chains and their spurs presented themselves foreshortened, in the way shown in fig. 232, which gives the appearance of a peak with two or more wings. On both sides minor glens debouch, and at the head of the principal glen we would see the outlines of a huge main range. I was mislead in this way by G_5; after getting well past it, until it bore south-east, I saw that it presented quite a different appearance, being altogether unimportant, merely one of the extreme outside protuberances of a fork of the mountains (see fig. 233), crowned by several others that rise a good deal higher; when we saw it foreshortened, due south, these were masked by the lower swelling. In the latter case the entire section has a flat appearance; but in the former it develops a wealth of relief details hitherto unsuspected. The shore-line, which looked so straight when viewed from the distance, is in reality very sinuous and devious. On the north side of the lake we actually travelled sometimes towards the south-east and south on the east side of each successive promontory and north on the west side.

Fig. 234.

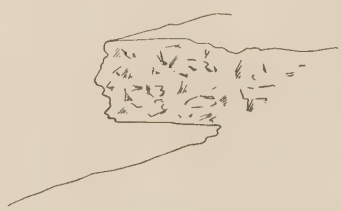


Fig. 235.

Fig. 236.

In the vertical face of a rocky promontory we discovered five natural grottoes, which had clearly once been excavated by water (figs. 173 and 174). In this locality the bushes grew by preference on the level strips of shore at the inner ends of the bays. Grass was remarkably rare.

We often observed beach-lines and strand-terraces; but it was only those at the bottom that we were able to study; owing to the steepness of the shores those higher up were not as a rule visible. A common type among these lower terraces is that reproduced in fig. 234. It presents the appearance of a broad ledge of detritus and gravel-and-shingle, compact and stone-hard; and not seldom there were three of them, each more or less undermined by the waves. The highest may have been 10 m. above the level of the lake, the middle one 5 m., and the lowest 1 m. They occur of course on those parts of the shore in which the conditions are

favourable; that is, where there exists a rocky slope with a steep fall and an accumulation of weathered materials at its base. These ledges furnish a striking proof of the fact, that the level of the lake is constantly falling. The upper part of each of these terraces will thus have been for a certain period an abrasion surface; after the lake has then dropped one or two meters, the base of the terrace will begin to be eaten into by the waves, and so become undermined, the result being a projecting ledge or cornice. The tenacity of the material is so great that the ledge will often project several meters and form a sort of roof over a grotto (fig 235). The terraces are, as it were, cemented to the face of the solid rock and occur with the greatest frequency on the eastern and western sides of each peninsula. For long distances these terraces make first-rate, level paths; but in consequence of the ravine-like gaps in them they are unsuited for a camel-caravan. A caravan composed of camels must find its way along down below them.

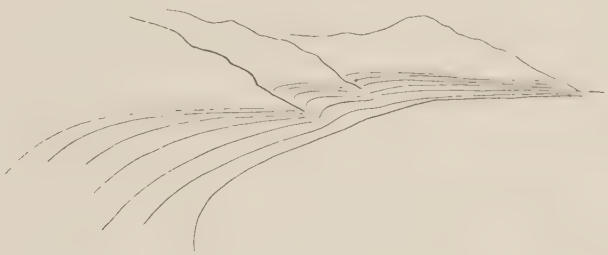


Fig 237.

The ground next the water in the penetrating bays consists of schor, that is to say, saliferous mud, often white with salt on the surface. Quite close to the shore-line runs a sandy rampart a couple of decimeters high, formed by the beat of the waves. Farther away the ground consists entirely of gravel. In the accompanying illustration (fig. 237) the regularly curved lines indicate these low ramparts of sand and gravel, which frequently, though at a considerable distance, reproduce faithfully the outlines of the existing shore. They are in fact mementoes of the lake's latest period of subsidence. Fig. 238 shows a series of these strand-ramparts in profile. That side of each such rampart which looks towards the lake is of course always the longer, the more distinct, and the steeper; sometimes the inner one is absent altogether.

Fig. 238.

After a difficult promontory, round which the men were forced to carry the more valuable part of the baggage, the shore ran towards the north-west. Possibly this is the reason why the vegetation — grass, scrub, and bushes alike — suddenly came to an end, the shore being then of course more directly exposed to the wind. Even in the bays that are relatively more sheltered there is an entire absence of

vegetation. Generally the northern shore of the Tso-ngombo is richer in vegetation than that of the Panggong-tso.

Under the force of the strong southerly wind which was then blowing the waves thundered against the beach, their abrasive energy being quite impressive. All day we failed to observe any mollusc shells, nor did we see any Algæ, though a certain striped appearance of the water a little way out suggested their presence. Of ice there was not now a trace to be seen. We passed the last in the deeply penetrating bay which I have mentioned: there several freshwater springs gush out, and it is their water, spreading out over the salt water, that freezes. Moreover the south wind, which was then blowing, effectually prevented the formation of ice along the northern shore.

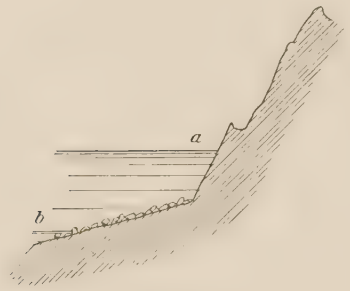


Fig. 239.

After another difficult promontory we came to a large bay, with an excellent, level strand. On its eastern side we found the merest sprinkling of grass, and on its west side four or five bushes, and higher up, near the eroded watercourse that runs down into it, some scrubby japkak. It was on this side of the bay, under the shelter of a rocky headland, that we pitched Camp CXLVI. The locality is called Gar. We did indeed discover a well at the edge of the lake, but its water was very little better than that of the lake itself. The sp. gr. of the latter was 1.0108 or a shade salter than at the preceding camp. All the way the prevailing rock was crystalline schist, black, dark green, and light green. So far as we were able to judge from the distance, the southern shore has a more abundant vegetation than the northern, partly because its level and soft strip of shore is very much broader, and partly because it is better screened against the wind. Its colour was yellow, and in one place we observed a large herd of yaks.

Along the rocky brow of the promontory at the eastern foot of which we were encamped we perceived distinct traces of an old road, roughly made by utilising

Fig. 240.

the outcrop heads of the broken strata and levelling up with flat pieces of slab (see fig. 239). It runs at least 10 m. above the existing level of the lake, and was used at a period when the lake advanced quite up to the base of the rocky wall. After the lake retreated from *a* to *b*, the gravelly scree came into view, and there was no longer any need to have recourse to the road above. Generally in proportion as the lake drops so does its shore become increasingly more favourable for marching on. Formerly the difficult rocky headlands were more in number than they are now.

Fig. 240 gives a schematic idea of how such a bay as that at Gar is constructed, and this may also serve as a ground-plan for most of the other bays that we came across. From a summit in the nearest main range two spurs run down at right angles to the shore, where they terminate in bold headlands. From each of these spurs a number of minor offsets jut out, more or less at right angles, and arranged like teeth in such a way that each »tooth» is backed on the opposite side of the spur by the space that intervenes between two other such »teeth». At the very end of the glen next the lake appear the old strand-ramparts; these are at the greatest distance from one another in the middle, but because of the increasing steepness they lie nearer together at the sides (fig. 241). From the lake-shore below no sign of the glen watercourse can be seen; though when you climb up above the highest terrace it becomes easily perceptible, split however into several delta-like arms. The reason why the watercourse is not visible farther down must be that, when in the rainy season the doubtless copious downflow of water is checked by the highest rampart, long lagoons and pools gather on the inner side of the same, and in them the sediment settles. From these dammed up pools above the water trickles down to the next rampart, where it again gathers into similar lagoons; and in like manner at the third, until finally it reaches the lake. It is this dispersion and distribution of the water that prevent a main watercourse from originating in the middle of the glen, and the same circumstances explain why the ground above each rampart is generally level, this being the effect of the sedimentation.

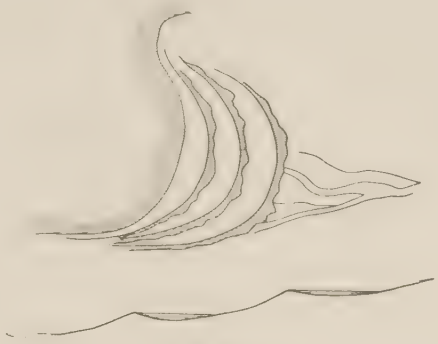


Fig. 241.

During the night of the 11—12th December there sprang up an exceedingly heavy storm from the north-west, and it continued all the next day with undiminished violence. Our camp however, which lay on the leeward side of the western promontory of the bay, was perfectly protected; but outside the promontory the lake was lashed into foam, while breakers thundered against the beach and the wind whistled through the mountains. The southern shore was completely hidden by snow-clouds; a snow-storm was raging on the Panggong-tso, and we seemed to realise how the wind, sweeping across its level expanse, and being forced in between those vast mountains, sensibly increased in intensity, driving as it were through a natural tunnel or rifle-barrel.

Fig. 242. A TYPICAL BAY OF THE NORTHERN SHORE OF PANGGONG-TSO.

Fig. 243. UP TO THE DIFFICULT PASS.

The track then skirted first the promontory next the camp, and next a smaller similar promontory which separates two little bays from one another. After that came a large cape like that which I have described in our preceding day's journey, and north-west of it followed a more deeply penetrating bay. This last is bordered on the west by a large, compact mountain spur, which does not allow of any passage round it at the bottom. The Tibetans had warned us of this place and predicted that it would be practically impossible for us to get our camels over it. After

Fig. 244.

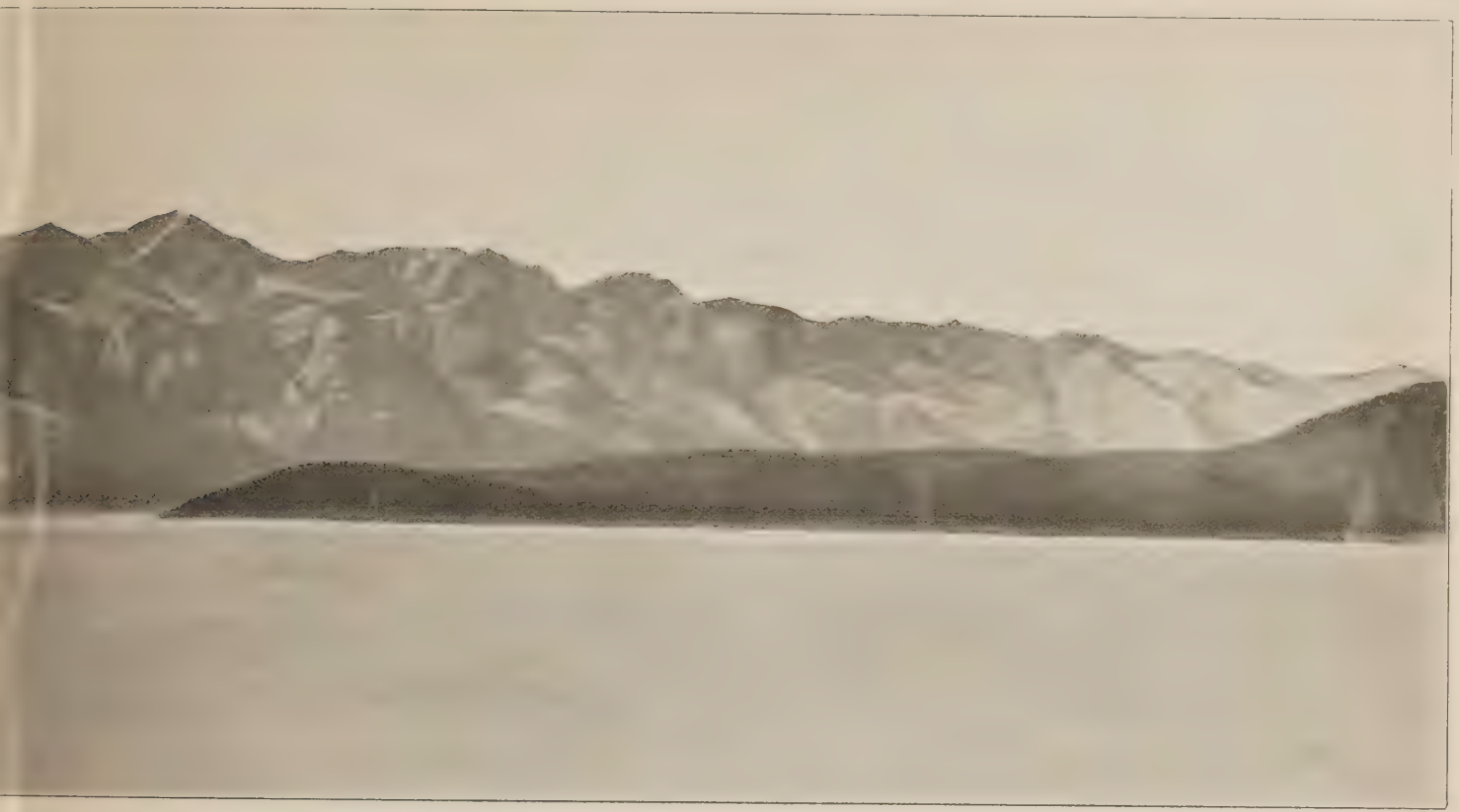
crossing the outlet of the big, broad glen that debouches upon the bay, we made a temporary camp at its western side, while we examined the base of the rocky spur. It turned out that it actually was impossible to advance. In two places the headland plunges vertically down into deep water, so that a man on foot could not possibly get past. The path that leads over the hindrance is a mere trifle for yaks, sheep, and men on foot, nor does it occasion any real difficulty to horses; but we had our camels to think of. The path climbs straight up the mountain side to the top and we had to sacrifice a couple of hours in making a zigzag track with axes and spades, and up it we then pushed and hauled our camels one by one. From a very awkward clay-slate knoll that lies half-way up to the pass I made the accompanying sketch (fig. 244) of the glen, looking down it and including the view across the bay and the lake, which, the snow having then ceased, lay spread out before me in all its glorious majesty. The path runs for the greater part of the way along the inner or northern side of a side-wing of the spur that terminates in the impassable headland. The summit of the pass is marked by a heap of stones, crowned with streamers on a pole. Thence the scene which unfolded itself was even more impressive: we commanded the entire north-western part of the lake, and saw how it is embedded between immense mountainous masses, clothed from base to summit with snow dropped by the last snowstorm. It was of course more particularly the southern shore of this peculiar lake, with its uniform breadth, which fettered our attention. It was easy to see that there exist on that side no difficult passages such as those which we had to surmount on the northern shore: the strip of strand is broad and level, though a great number of transverse glens, with gravelly screes, open out upon it. One of these is particularly large, and in the middle of it there was a gleam as of water. Right away at its head rises a chaos of gigantic crests, peaks, and chains. We were not however allowed to enjoy this fascinating spectacle for long, for the storm broke out again, and raged with unexampled violence, and in less than a minute we were chilled to the bone and almost frozen.

Fig. 245. A DIFFICULT ROAD FOR CAMELS.

The descent on the west was very little better than the ascent. At first it was easy, for we went down the gently inclined slope of the crest of the spur, but eventually we came to another place that was absolutely impassable for camels. The path clings like a coping to the side of a precipice, but it is too narrow for camels. Fortunately we were able to take them a roundabout way, though even that was down steep, barren slopes, until they reached the next level expanse of shore, and there we pitched Camp CXLVII. The locality is said to be called Schovoto, and there we found a well containing perfectly fresh water, and also some bushes and japkak scrub.

MOUNTAINS ON THE SOUTH

VIEW OF T



RE OF WESTERN PANGGONG-TSO.

T CAMP CXLVII.

CHAPTER XXI.

THE WESTERN PANGGONG-TSO.

The configuration of the shore west of the pass is more irregular than usual, and the scenery wild and fascinating owing to the capricious relief. Here occurs a circular bay, with a relatively narrow opening towards the lake. On the east it is bordered by the spur which we had just crossed over. From this a pointed cape projects west, the sides of which go sheer down into the lake. Then follows a flat expanse of shore, which seems to owe its origin for the most part to the fact, that the sediment washed down from the mountains has been carried to the leeward side of a smaller cape and has there accumulated. This inclosed bay sweeps round for a great part of the way in a regular curve, while the usual strand-ramparts, marking the lake's subsidence, are visible on its flat expanse. On the west the bay is bordered by a cape of a more unusual shape, namely a naze projecting southwards and bearing a solitary knoll at its extreme tip.

Fig. 246.

The flat ground in the outlet of the eastern glen has something of the appearance shown in fig. 246. The darker lines indicate the outline of the base of the hard rock; the outlets of the side-glens are occupied with yellow gravelly screes, descending steeply towards the principal glen. The flat scree of the latter is furrowed by a number of watercourses more or less deeply incised. The deepest is only $^1/_2$ m. down, but its sides are vertical, a proof of the energy of the erosion. This watercourse reaches down to the lowest strand-rampart, but is not now able to break through it. As however this rampart is low, it is fair to assume that it is occasionally broken through when the torrent is especially big, but that the action of the waves builds it up again.

Owing to the cloudy weather and the snowfall of the last two days the temperature had risen: on the night of the 11th—12th Dec. the thermometer only dropped to — 7.5°.

On the 13th December the wind again blew hard from the west. We were then travelling towards the north-west, and thus had on our left the cape with the terminal knoll, shown on fig. 247. The cape rises at its highest 3 m. above the level of the Panggong-tso, and at its narrowest part possesses a little lake, about 10 m. in diameter, then frozen. Beside it we observed signs of higher levels, and it cannot be long since the little knoll formed an island close to the shore. In the Panggong-tso, by the way, we did not see a single island. After that the shore continued to be uncomfortable, being steep and stony, and we often had to level it with our spades and roll aside big stones that lay in our way. Next follows a large bay, not penetrating very deeply inland, with a level shore, on which bushes and scrub were growing. On the west it is bordered by a pronounced headland, which forced us to incline south-west, and after that by following the shore we were turned for a pretty considerable distance towards the north, passing a couple of small pointed capes. The shore there is extremely picturesque. The cliffs, consisting of black and green schists, dip 70° towards the south; the faces of the rock are often as bright as metal and glittered in the sun. Below the cliffs we had, the whole of the way, the above described terraces of »cemented» gravel-and-shingle, masking their base up to 8 or 10 m. above the lake. Fig. 248 shows one such terrace, and furnishes a proof that these formations are parasitic in their nature, and owe their origin to the saltwater operating amongst the disintegration material, both coarse and fine. Off these terraces the lake always appears to be of considerable depth; at even only a few meters from the shore the water has a dark look. These loosely affixed terrace-formations are not seen higher up; the reason probably is, that they have been destroyed by the atmospheric agencies since the lake dropped sufficiently to expose them.

Fig. 247.

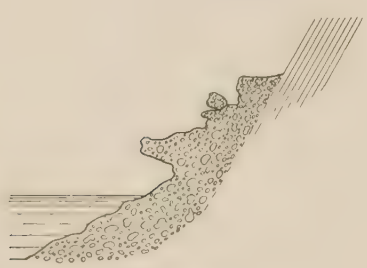


Fig. 248.

After travelling for a space towards the west-north-west, we approached a peninsula jutting a fairly long way out; but it is so low that we were able to march straight on over it by a lower threshold pass. West of it lies a bay with a level strand, on which japkak scrub was growing luxuriantly. Here, but only on the sheltered side of the scrub and the erosion terraces, a few patches of snow were still lying, left from the last snow-storm. Upon this bay debouches a fairly big glen coming from the east. The brook that courses down it has excavated a channel 3 m. deep with vertical sides; but it is not until it almost reaches the lake that it exhibits these emphatic results of its energetic erosion, for at only a couple of hundred meters higher up the water-course was so shallow that our camels were able to cross over it. The explanation

of the difference lies clearly in the subsidence of the lake. If we suppose that the lake-level is at *a* (see fig. 249), then the erosion terraces will be relatively low. After a time the lake-level will drop to *b*, and as a consequence of that cataracts must be formed in the lowest part of the glen. This again will in a high degree increase the erosive power at that point, and this enhanced erosive activity will advance slowly upstream. At about 200 m. from the existing shore it was quite easy to discern the point to which the brink of the cataract has receded. In proportion as the lake drops, the greater will grow the energy of this retrogressive erosive activity, and the higher will grow the steep erosion terraces which fence in the watercourse. At the bottom, next the lake, they are now 3 m. high. All the indications connected with the outlet of this glen seem to suggest that the lake is shrinking at a fairly rapid rate. In any case the shrinkage is so rapid that the erosive activity is unable to keep pace with it; for were it able to do so, there would be no cataract sill in the channel. At the time we saw it, the channel was perfectly dry.

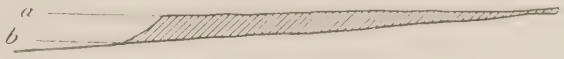


Fig. 249.

The next peninsula is formed by a rocky spur with steep sides. This we had to cross over, and at its western foot, that is on the eastern side of a deeply penetrating bay, we pitched Camp CXLVIII. The locality is called Sertse, on the English map Churtse. Here debouches from the north a very broad glen, the outlet of which constitutes the relatively extensive plain of Sertse. It was here that I was met by a relief caravan sent out from Ladak.

Fig. 250. CAMP CXLVIII.

At last on 14th December we had fine weather, a perfectly clear sky and a gentle breeze from the west. The mountain panorama of the southern shore now stood forth in all its glory, brilliantly white and blue. In its higher regions we could

Fig. 251. CAMP CXLVIII. IN THE FOREGROUND THE TERRACE FROM WHICH THE STREAM ISSUES.

Fig. 252. CAMP CXLVIII. TENTS OF THE LADAKIS.

just make out what we guessed to be occasional short glacier arms. Directly opposite to us, or S. 43° W., were the village and fields of Man, and beside a glen traversed by a spring-fed stream were houses and steadings in several places.

Quite near to our camp and close to the lake-side a copious spring gushed out. With the temperature of the air at —6.0° at 1 p.m., the temperature of the water in the bay was + 6.1°, the difference being attributable to the spring just mentioned; for the temperature of the spring-water was + 16.2°, so that the water was tepid. It was as bright as crystal and perfectly fresh, and issued in a continuous

stream at the base of a vertical terrace 1 1/2 m. high; it gives rise to a rivulet, which, about 10 or a dozen meters lower down, makes its way into the lake. By its means the water in the fairly land-locked bay is kept relatively warm and fresh. The spring rivulet crossed the bay in a curving current, from which steam arose all day, even when the sun was shining, thus giving rise to a strange and unusual spectacle. In the morning the clouds of steam were so dense that they hid the southern shore almost entirely from our sight. In the rivulet from the spring Algæ were flourishing and the usual Crustaceans were present.

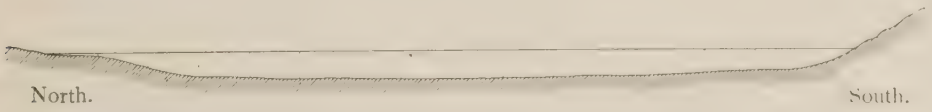


Fig. 253. 3.12 23.0 37,23 37,06 38.10 39.0 40.0 40.0 40.15 40.35 38,73 36.92 33.55 30.60 28.24
Breadth = 11,800 m. Horizontal scale = 1 : 100,009. Vertical scale = 1 : 10,000.

The stormy days made me somewhat anxious about Tschernoff in his trip across the lake; but once or twice we had seen him and his companion, and their bivouac fire, on the opposite shore; from this we knew that they had not been caught in a storm out on the open lake, which in consequence of the high waves would have been decidedly dangerous. We now at length caught sight of the skiff steering straight for our camp from the locality of Man, a little east of the village.

Fig. 254. LADAKIA TENT AT SERTSE.

The weather had prevented them from taking more than two series of soundings. These were however sufficient to prove that the Panggong-tso is not only bigger and broader, but also deeper, than the Tso-ngombo. The first series started from Camp CXLV and ran diagonally across the lake towards the S. 65° W., a distance of 11,800 m. Soundings were taken at 15 stations, that is, once every quarter of

an hour during the journey, the speed of which was controlled by the velocity instrument. The result is shown in the accompanying profile (253); from that it appears that the southern side of the lake is only a trifle steeper than the northern side. The profile proves that the basin of the Panggong-tso is characterised by the same feature as that of the Tso-ngombo, namely its bottom is extraordinarily level, forming in fact a trough, which from its deepest point, 40.35 m., slopes with the utmost gentleness up towards the shores, but upon approaching close to these it ascends rather abruptly. Throughout by far the greatest part of its area the depth varies extremely little: in ten out of the fifteen soundings the variation was not more than 3 m.

Fig. 255. 25.85 47.50 45.88 39.00 22.05
Breadth = 5,250 m. Horizontal scale = 1 : 100,000. Vertical scale = 1 : 20,000.

From the cape where this line of soundings terminated, the two men followed the southern shore, and the Cossack made a preliminary map of it. Next day, as a violent gale was blowing, they were only able to traverse a short distance to another projecting cape. The third day they followed the shore farther towards the north-west, passing a village of 5 or 6 houses, with one or two willows growing beside them, and spent the night in a second village, consisting of a dozen scattered huts. On the 14th December they continued on to Man, which consists, they reported, of about 25 houses. They were everywhere received with the greatest hospitality by the people, who supplied them with provisions, and whilst the storm lasted lent them a horse to carry the skiff. From Man they steered N. 26° E. to

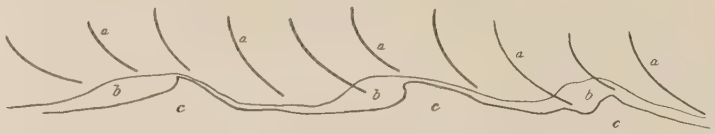
Fig. 256. A BAY WEST OF SERTSE.

our camp at Sertse, a distance of 5250 m., taking 5 soundings on the way. Along this stretch the deepest place was 47.50 m., situated as before rather nearer to the southern shore than to the northern. This depth corresponds almost exactly to the greatest which I first sounded in Tibet, namely in the freshwater lake between Camps XXXVIII and XXXIX (1900), where the depth amounted to 48.67 m. Thus according to our soundings, the Panggong-tso is 16 m. deeper than the deepest part of the Tso-ngombo. Generally it holds good with regard to these soundings, that the depth increases towards the west, so that possibly there exist even greater depths west of the line last sounded, though it is more probable that the lake bottom soon begins to rise towards the level plain situated at the western end of the Panggong-tso.

Fig. 257. FROM CAMP CXLVIII.

December 15th. At Sertse we divided. The caravan made a detour, starting up the big glen which opens on the north, and then crossing over a relatively easy pass, in an offset of the hills, so reached the next camp beside the next bay. This was at all events an easier route than that which I followed along the water's edge. After riding a considerable distance across the steep gravelly slopes, we climbed painfully up to the pass, situated in the crest of the spur that forms the eastern boundary of the next bay. The pass is crowned by a cairn of stones. Over on the other side we followed the shore towards the north-west at about 40 to 50 m. above the lake. The shore-line is pretty straight and the mountain-slopes are not interrupted by any noteworthy glens, watercourses, or ravines. Down below, at the base of the slope, there is generally a narrow fringe of flat shore, a few meters broad and occasionally running out into miniature capes. The bottom of the abrasion terrace consists of white sand and gravel, imparting to the bright lake water a light green colour. As we rode along up above, we could distinctly see how these white patches at the bottom were far broader on the east side of

each little cape than they were on the opposite western side. The difference is due to »shore translation», the effect of the waves beating obliquely upon it, and bit by bit transporting the material to the leeward side.



a=waves. b=shallow patches. c=capes.
Fig. 258.

After that we approached a fresh bay and followed its eastern side due north, passing on the way two stone sheepfolds in a locality called Ilung, or Illung, as the English map spells it. Instead of continuing on beside the pass, which was said to be difficult from that point, we struck up the glen that opens upon the bay, and leads up to a little pass. The English map does not show any path at all along the lake-side; the route over the pass is certainly always used. The ascent is steep; the track keeps all the way to the watercourse; and the mountains on both sides grow relatively lower and lower and approach nearer to one another. Even the fresh horses which had been brought us from Ladak felt the climb, for they frequently had to stop and rest. Small patches of snow still remained here and there. The pass itself (alt. 4913 m.) is flat and rounded, and is crowned by a cairn of stones. Here again we had an opportunity to enjoy the glorious view. The lake was as if confined in a narrow trench far down below our feet, and in comparison with the world of mighty mountains which encircle it on all sides, it appeared quite insignificant. To the north-west were immense crests; on the south shore a labyrinth of mountains said to be called Jagtse-bombo. The spur which extends south-west from the pass appeared to be connected uninterruptedly with them, so much so that it was difficult to make out how the lake penetrates between them.

The descent from the pass towards the north is at first rather steep; but the descending watercourse with its *thalweg* soon turns to the north-west, and the slope then grows gentler. Below us we beheld the innermost part of a bay of the Panggong-tso, namely the bay that penetrates farthest inland. As it approaches the level shore, the glen widens out considerably. On our way down we passed on the left a small detached rocky knob. Except for some teresken and grass, both extremely thin, growing on the flat shore belt, the country was very barren. We pitched Camp CXLIX at the very head of the bay in a locality called Solung-tschok, the name on the English map being Soulon-kiok. There a spring gushes out at the very edge of the lake, the temperature of its water being + 15.1°; but it trickled out so slowly at the foot of an overhanging terrace that it took a considerable time to get a can filled. The sp.gr. of the lake water in the bay was 1.0102, consequently less than in the places mentioned before, a fact which suggests that springs issue at the bottom of the lake. Notwithstanding that the bay is well protected by the great spur on its western side, it was nowhere frozen. Our new guides declared that summer and winter alike the lake maintains the same level; but it is

little likely that they have taken any note of the changes which may have occurred Here again ramparts and rings of white salt indicate that the lake formerly reached a higher level.

Fig. 259. SOME GROUPS OF THE LADAK RELIEF EXPEDITION.

The bay is long and narrow, and picturesque, and penetrates inland a distance equal to the breadth of the entire Panggong-tso; in fact it resembles a fjord clasped about by vast mountain-spurs. On the southern shore is the village of Pangmik with three steadings. The day was genial and still; but in the afternoon the sky was covered with dense clouds and some snow fell. It was a long time since we had witnessed the fall of snow; but in this respect that winter was said to be quite exceptional.

On the 16th December we at first followed the shore for a space, passing a cape and a bay; but at the base of the next cape we turned away from the shore, and went up a sort of ravine between rocky heights, which took us to the west-south-west, though afterwards we travelled for the most part on soft detritus, having quite close on our right the upper course of the deep-cut erosion channel. The pass itself is flat, and scanty scrub was growing. The snow increased in quantity the farther we advanced west: at the west end of the lake it even lay on the level ground, and not on the crests and slopes of the mountains only. The western de-

Fig. 260. SOME GROUPS OF THE LADAK RELIEF EXPEDITION.

clivity from the pass is more gentle than the eastern, and is smothered under sand, both soft and deep. This brought us over the great spur that borders the big bay on the west. It would probably be impossible to get round its extremity. From Camp CXLIX we counted on its eastern side also six capes, one after the other, and all having a steep descent into the lake. All the same the route *via* the pass means a considerable detour.

After passing the outlet of a considerable glen coming from the east, we again approached the shore. Looking back towards the east we then saw only one less accentuated cape of the big spur, the reason being that the last bay on the north side of the lake does not penetrate very far inland. After passing yet one more cape, we turned our backs upon the extreme north-western bay of the Pang-gong-tso and crossed the lacustrine plain towards the outlet of a glen which we

saw gaping wide in the south-west. This lake does not end like its eastern neighbour in a point, but in two bays of the same size, separated from one another by a gentle outswelling of the shore-line. The surface features in the north-western

Fig. 261. WESTERN PANGGONG-TSO.

Fig. 262. ON THE ROAD TO THE PASS WEST OF SERTSE.

continuation of the great water-filled latitudinal valley are however very different from those of its eastward continuation. In the latter direction we found the country relatively open, there being two broad, flat valleys, which may be regarded as the continuation of the lacustrine valley. Westwards however, while two glens again

Fig. 263. VIEWS FROM THE PASS WEST OF SERTSE.

Fig. 264. ON THE PASS OF DECEMBER 16.

debouch upon the lake, one from the north-west, the other from the west-south-west, they are both narrow and deep, and in point of scenery have nothing in common with the big latitudinal valley which contains the Panggong-tso. The level expanse which forms the direct prolongation of this lake is narrow and insignificant, and is bounded on the west by the imposing mountain-mass that separates the two glens one from the other.

This little plain is however of rather a peculiar character, for it very closely resembles a miniature desert. Its surface consists exclusively of soft sand, arranged

Ljustr. A. B. Lagrelius & Westphal.

VIEW OF THE BAY AT CAMP CXLIX.

Fig. 265. THREE OF OUR LADAKIS AT SERTSE.

in sedimentary dunes, generally disposed in long lines, and often with scrub growing on them, which converts them into small mounds of the usual East Turkestan character. The plain is crossed diagonally by a river-bed of the highest importance, about 6 m. deep and in general a hundred meters or so broad, and inclosed between scarped erosion terraces, which show admirably the several layers of clay and sand. At the bottom lay an almost continuous ice-sheet, broken only in the middle by a long, narrow bank of sand and mud. No running water was however visible, though possibly there may have been a current underneath the ice. This river issues wholly out of the glen which we saw opening to the north-west, though higher

Fig. 266. THE NORTHWESTERN BAY OF PANGGONG-TSO.

up it is formed by two other glens, of which the one on the south is the larger, having energetically cut its way down into the immense snow-clad mountain-masses. Even the surface of the plain itself was thickly dotted over with thin snow-drifts; but heavy drifts were accumulated against the western escarpment of the river. To judge from the energetic sculpturing, vast quantities of water must make their way down this channel in summer, and the water in the western extremity of the lake will then be a good deal freshened up.

Fig. 267. OUR LAST TIBETAN.

After traversing the remainder of this lacustrine plain, which is known as Lukkong, and on which we came across three tents, we approached the sharply defined edge of a steep terrace or platform built up entirely of detritus. Its eastern margin is in fact so sharply accentuated that it might readily be considered, mistakenly, as a former position of the right bank of the river, the stream having subsequently shifted farther to the east and destroyed its own left bank. However we soon descended from this platform and found that its opposite face, looking upon the outlet of the southern glen, bears precisely the same appearance as the eastern face, which suggests that it has been modelled by the stream that flows down that glen. This however is not the case. The platform terminates in a point running out towards the south-east and it simply consists of the continuation of the rocky headland which rises above it, or rather of the flattened gravelly scree at its foot. The most surprising thing however is that in the southern glen, into the throat of

which we now entered, there is no drainage-channel whatever, although I fully expected to see one of the same size as that in the north-western glen. There was it is true, a tiny rivulet; yet it was quite insignificant, and did not belong to the main glen, but came out of a small side-glen that pierces the mountains on the south. Of this puzzle we were soon to discover the explanation.

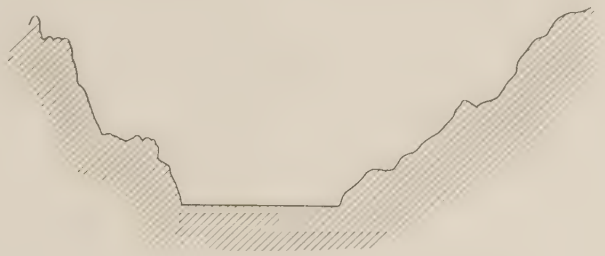


Fig. 268.

The bottom of the valley, which ascends slowly and irregularly towards the south-west, is completely choked with gravel and stones, wholly products of disintegration, which have tumbled down from the surrounding mountains and make the track exceedingly uncomfortable. We passed a very beautiful obo, consisting of two stone kists, one, on the east, covered with well-carved *Mane* formulæ, the other, on the west, bearing poles and flags. Soon after that we approached a little pass, and there we discovered the explanation of the puzzle, an explanation which throws a most interesting light upon the orographical problem as a whole. The pass is so low and slight that it would escape notice were it not that the watercourse which emerges from it runs to the west, betraying that the surface slopes in that direction and not towards the lake. Consequently the obo in the glen by which we ascended marks the western boundary of the hydrographical area of the Panggong-tso, and we had consequently now entered the drainage-area of the Indus. From that point we should definitively leave behind us the elevated and relatively flat highlands of Tibet, where the surface modelling is less energetic, and should be travelling down to lower levels in a peripheral region. Thus this little pass, although scarce discernible, possesses greater orographical and hydrographical importance than the great passes which we crossed over in the vast Arka-tagh. While the latter merely form a hydrographical boundary between the Lop-nor region and the self-contained drainage-areas of central Tibet, the former constitutes a dividing-line between the inland drainage regions of Central Asia and the Indian Ocean.

Leaving the threshold pass behind us, we rode slowly down a big imposing valley, quite broad, its floor level and for the most part strewn with sand, interspersed at intervals with patches of stones and gravel, bushes and scrub, though these last were thin. Except for small watercourses, formed by the latest rain, and soon coming to an end, this great valley also is destitute of streams. In profile it presents the appearance shown in the accompanying sketch (fig. 268); that is to say the bottom of the valley makes an even line between the bases of the mountains on each side, and throughout the whole of that *thalweg* there does not

exist a single edge to betray that water in noteworthy quantities ever courses down it. It was not until we had passed the outlet of a side-glen coming from the left that we perceived any erosion channel; this carried even then a little water, though it was divided into several arms distributed over its pebbly bottom, and most of them frozen. Entering the principal glen, it forms an orthodox channel, in which however both water and ice were soon swallowed up amongst the gravel. The bottom of the valley contains indeed a good deal of sand. After that several small steep transverse glens open out on both sides. Scattered along the foot of the lofty mountain walls there are a goodly number of more or less free-standing knolls and buttes. Amongst certain of these was a tiny frozen lake, called Tschakar-tala or Sovar, which filled the whole of the bottom of the valley. It is more probable however that the vast expanse of ice which we saw was formed by spring-water, which had thus frozen into sheets. The absolute altitude amounted here to 4254 m., so that we were now 63 m. *below* the level of the Panggong-tso. The rocks consisted for the most part of schists, granite, and quartzite. On our way down from the first pass we came across one or two fragments of granite. I did not however observe directly any signs of glacial activity. All the same the impression arose in my mind, that the elongated depression in which the lakes lie, and which orographically really is a latitudinal valley, once served as the pathway for a big and massive glacier, which had its gathering-grounds and *firn*-basin to the west, and itself travelled east through the valley; and it is in consequence of this that the bottom is so smooth and level as we actually find it to be. Otherwise it is difficult to account for its possessing these properties. In valleys in which there exists no reason for supposing glaciers ever were present, the bottom is seldom so level; generally indeed there exist several cross-thresholds, passes, and similar irregularities of surface. There do, it is true, exist irregularities of this character in this great valley, more particularly the isthmus between the Tso-ngombo and the Panggong-tso; but this in no way militates against my supposition. For it must be remembered that it is just at that point that the great glen of Niagzu debouches from the north, and during the epoch in which the climate was moister than it is now an incomparably greater volume of water must have come down that way than the existing eroded watercourse would lead one to suppose. For a long period this river brought with it vast quantities of gravel and mud, and out of them formed a delta, which encroached progressively upon the lake, until finally its flat scree reached right across it and cut it into two separate basins. In the extreme east we also observed similar divisions between the small lakes that constitute the beginnings of the Tso-ngombo in that quarter. It is moreover a noteworthy fact, that the depth decreases from west to east and that the decrease appears to proceed with the greatest regularity; this suggests an erosive force acting with the greatest energy at the root of the glacier and of necessity decreasing towards its extreme tip. Then however we are confronted with the difficulty of explaining the possibility of movement on the part of the ice-stream along what was practically level ground, or even somewhat rising ground, unless we can imagine that the eastern lake-basins became at a subsequent period more filled up and consequently shallower. I must however leave this problem to geologists to solve.

LOOKING WEST FROM THE PASS EAST OF SOLUNG-TSCHOK.

MOUNTAINS SOUTH OF THE WESTERN PART OF PANGGONG-TSO.

LOOKING N 76° W FROM THE LAST PANGGONG-TSO PASS.

LOOKING S 66° E FROM THE LAST PANGGONG-TSO PASS.

I will now touch briefly upon the observations that I made with regard to the relations existing between the Panggong-tso and the drainage-area of the Indus, but only briefly, because my journey to Leh was too hurried to admit of my taking extended observations. I had thus ascertained that the lake-system of the Tso-ngombo and Panggong-tso is as a whole limited on the east by the gently ascending plateau country, bordered on north and south by gigantic mountain-ranges, and in the west possesses no more emphatic line of demarcation than the low sill or threshold to which I have alluded, and which in its longer cross-section presents the appearance shown in fig. 269. If a not very

Fig. 269.

deep gap were to be cut through this barrier, the lakes would secure an outlet to the west, and would empty their surplus water into the Indus. With regard to the height of this threshold above sea-level, I am unable to make any satisfactory statement. According to the reading of my aneroids, compared with those of the boiling-point thermometers, it ought to be 4327 m.; but before we can use this datum as a basis for safe conclusions, the exact value ought to be accurately known. I have mentioned above the existence of a strand-terrace at an altitude of 54 m. above the lake. When the basin was filled up to that level, it had of course an outflow towards the west over the top of the low sill, and the altitude of the latter above the level of the lake is at the present time perhaps the same, or only a little lower than, the altitude of the terrace, although the aneroid reading gives it a height of only 10 m. above the lake. Once, but at a very distant epoch, the lake received such copious supplies of water that the efferent stream to which they gave rise was a large river. The circumstance that this left behind it no erosion terraces in the neighbourhood of the little threshold pass does not necessarily prove very much, because the bottom of the valley has since that epoch been levelled down by the progressive denudation. Moreover the efferent stream was possibly so powerful that it occupied the greater part of the width of the valley. Since the climate grew drier, the volume in this efferent stream has also grown less, and during this period erosion terraces will in any case have been formed in the bottom of the valley. Finally the drop in the level of the Panggong-tso has proceeded so far, and advanced at such a rapid rate, that the erosive energy of the outgoing stream was not able to keep pace with it; for had it done so, it would have been able to carve a passage for itself down through the threshold barrier, and to-day the Panggong-tso would still possess an outlet just as the Tso-ngombo does. But this is not the case. The Panggong-tso has become cut off, and now forms a self-contained salt-lake, which does not receive sufficient inflow water to compensate for the loss through evaporation.

Prior to the moment at which the lake was cut off, it may be assumed, that its level remained constant for a very long interval of time, and that that level was prescribed by the height of the western sill or threshold barrier. No matter how great or how little the amount of water that the lake then received, the surplus would always find its way out at the western end, the sill therefore serving as a regulator of the level. If now, as I suspect, the altitude of this sill corresponds to the 54 m. terrace, or even if it lies rather lower, the depth of the outgoing stream being added, we obtain a plausible means of accounting for the absence of observable terraces above the 54 m. altitude, as also for the fact of this terrace being more distinctly developed than those which lie at a lower level than itself. It is the memorial of a level at which the lake remained constant for an exceptionally long period of time. The Tso-ngombo is at the present day in a precisely similar situation, for its efferent stream regulates its level and keeps it constant, so that the strand-terrace which is now being formed by the action of its waves has every prospect of being powerfully developed. If at any time the inflow into the Tso-ngombo should be, as I have assumed it will be, too small to occasion an overflow, the same fate will then overtake that lake which has already overtaken the Panggong-tso: it will be cut off, and will turn salt. Judging from the slight degree of salinity which the water of the Panggong-tso exhibits, it cannot be very long since that lake was cut off: the water is not too salt but that yaks and dogs will drink it. The existence of mollusc-shells on its shores is evidence that the lake actually was fresh once. Possibly molluscs are still living in its fresher parts, for instance in those localities in which there are several springs or in the vicinity of the mouth of the stream from the Tso-ngombo; but as the salinity will increase, the molluscs are doomed to die.

Fig. 270.

According to von Richthofen, the peripheral regions are increasing in area at the expense of the self-contained inland-drainage parts, as indeed is natural, seeing that erosion is eating its way back into the heart of the continent, proceeding from the coast upwards. But if my observations and deductions are sound, we have here an instance of an exception of a peculiar character, namely a region which formerly had an outlet to the sea, but subsequently, in consequence of climatic changes, has passed over to the central regions of self-contained drainage. And I have no doubt that similar instances could be met with elsewhere.

The subjoined observations of Strachey are interesting when compared with the reflections which I have made above, although he gives to the lake an altitude of only 13,400 feet (4085 m.) and puts the beach-lines at only 70 feet, while he considers that the water-dividing threshold lies 100 feet above the lake. According to Rawling, the altitude of the lake is 14,000 feet or 4268 m., which comes nearer to my result of 4318 m. Strachey says: »The Panggong has no effluence what-

ever; bute there is an open valley connecting the N. W. end of its basin with that of the Tanktse affluent of the Nubra river, via Muglib, the length of dormant drainage between the edge of the lake near Jaktil, and the first appearance of the Muglib rivulet in a scanty spring at Wangtong being 7 or 8 miles; and the spring, being sub-saline, is considered by the Tibetan inhabitants as a filtration of the lake water. The watershed across the head of the valley is almost imperceptible, but lies probaly at Donzho Lhato, only a mile from the lake, and scarce 100 feet above its present surface. The present level of the water is about 13,400 feet.

All along the banks of the lake there is a well-defined zone of horizontal watermarks, extending to a height of perhaps 70 feet above the present surface, formed both by calcareous concretions and by erosions on the foot of the marginal rocks, corresponding marks being also visible in parts of the alluvial shore; and the uppermost of these lines no doubt marks the level of the existing watershed at Donzho. The gradual subsidence of the lake is established by further evidence. The plain at Ot, which is raised only 10 or 12 feet above the present water-line, consists of fine earthy strata full of small shells, which are very perfect and unaltered, if fossils at all of the most recent sort, and some of them closely resembling (if not identical with) a small species still living in the Tso-Rul, though none were observed in the water of the Pangong itself. Although the inhabitants of Pangong have no tradition regarding the origination of Ot by the subsidence of the lake, its gradual desiccation in the present (i. e. human v. historic) era seems probable; and I was informed by a Tibetan, who had visited the lake in company with Moorcroft in 1821, and again with myself in 1848, that the water had receded perceptibly from the encamping ground at Jaktil during these 27 years, which, as the shore there is flat, might have been done by a very slight subsidence of the water.»*

* *Physical Geography of Western Tibet*, by Captain H. Strachey, in *Journal of the Royal Geographical Society*, vol. XXIII, p. 47 (1853).

CHAPTER XXII.

FROM THE PANGGONG-TSO TO LEH.

On the 17th December I rode to Drugub, leaving the caravan to follow slowly after me. The valley is not broad, but it is only really narrow and confined in those places in which the gravelly screes meet from both sides. Such places are on the whole very numerous in this valley and the screes of great size, and thus bear evidence of an active disintegration. There are any quantity of blocks of grey granite, and sometimes the big screes of these fragments made riding difficult; black schists also occur. At length the valley widens out to an open grassy plain, though the grass had been closely grazed. Above this, and pretty high up, we observed a terrace. On the same side of the valley is a copious spring known as Palung-tuksi. Its rivulet trickles along a deep, narrow bed, with mossy, grass-grown sides, which makes its way down the black schists on the right side of the valley. A frozen lake at Camp CL sent out a rill, it is true, but it soon came to an end; but the rivulet from the Palung-tuksi continues on down the valley, although at no great distance below the spring it was then frozen. It contained some small fish, but lower down the fish were both larger and more numerous. A little bit farther down the valley there was another ice-sheet, and yet another clothed, as it were, with a breastplate, a gravelly scree which overhangs the station of Mukleb on the left side of the valley. At that place there is a station-house surrounded by other huts and willow-trees, and, on the right side of the river, a couple of corn-fields, irrigated by a canal. We also observed an obo, with a *tschorten*.

Erosion terraces were noticeable at intervals on both sides of the valley, though they are frequently broken or damaged by gravelly screes. At Dschagtag there are one or two steadings between the river and the left side of the valley, leaving but a narrow passage. Every now and again we passed a picturesque cape, as well as small isolated rocky »snags» sticking up from the level floor of the valley. In a corner near a headland we came upon a waterfall, barely a meter high, though it was then frozen into a solid mass of ice.

At this point the valley all at once changes its character. Wheeling abruptly to the south-west, it runs for some distance due south, and at the same time becomes wild, and choked with gravel and fragments of grey granite. Often we rode

along real tunnels or corridors fenced in by stones of different sizes, sometimes measuring 50 to 100 cub.m. The granite there is of every possible variety, mostly in light shades, yellowish red or light grey, sometimes coarse-grained, sometimes fine-grained, but frequently also striped. From the point where we turned to the south-west, we found ourselves in a peripheral region, the valley being deep, wild, and narrow: we had not seen anything like it since we left the Tscharklik-su. All the valleys and glens that we came into contact with on the Tibetan highlands were less energetically excavated, the denudation products in their bottoms being pulverized into fine gravel, or usually sand and dust, while the mountains that border them are relatively of minor elevation and their sculpturing less accentuated. The glen of Tscharklik-su is on the contrary deeply cut; but then it belongs in a manner to a peripheral region, if we regard the whole of the Tibetan upswelling as a physico-geographical unit. Strictly speaking however this glen also belongs to the central regions with self-contained drainage, though in its particular case this character is of less importance. All the streams that descend from the Tibetan upswelling have carved out deep channels for themselves, not only in the south, the east, and the west, but also in the north, where the stream of the Tscharklik-su ends in the basin of Lop-nor.

Fig. 271. THE FIRST HOUSE ON THE ROAD TO LADAK.

Upon looking back up at the point where our valley turns to the south-west, swinging round a sharp elbow, it looks as though it were a big side-glen from the right which causes it to change its direction; but there exists no such side-glen. At the point in question the valley is joined by only three small gullies or steep fissures, which start on the summit of the nearest mountains and form at their lower end vast screes of accumulated gravel. In unison with the phenomenon which Richthofen calls »diagonale Stromverschiebung», the river cleaves a passage to the left,

almost at right angles with its previous direction and without any stimulus from the right, and in that way takes the shortest cut through the granite. It is, in a word, a magnificent transverse glen, short, narrow, wild, and picturesque. At the actual elbow, where the valley changes its direction, we observed, at a good 100 m. above its bottom, some especially well defined terraces, interrupted at only a couple of places by fissures and gravelly screes. During the period in which this valley served as the outlet conduit of the Panggong-tso, and when the volume of water that streamed down it was immense in comparison with that which it now carries, the valley was excavated with great energy, the effect being such as nobody would for one moment attribute to the existing little brook, even making allowance for its summer high-water. It is clearly from the same period also that the side-terraces date; and it is noteworthy that they have been built up with especial distinctness at the elbow on the right side of the valley, where the full force of the current spends itself. There too the rocky walls are precipitous, whereas on the opposite or left side they slope gently down to the bottom of the valley. From that point the terraces continue all the way down to Drugub, growing bigger and more distinctly defined as they proceed, so much so indeed that they not seldom constitute the peculiar and salient feature of the landscape.

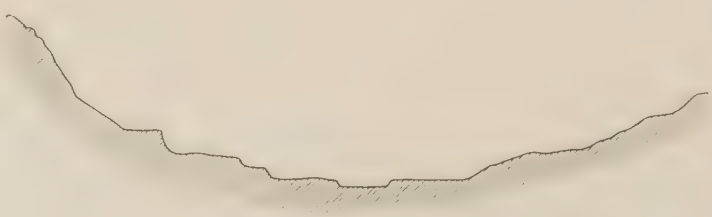


Fig. 272.

On the right side of the valley is a curious sort of place known as Samkang. In a hollow a little bit above the bottom of the valley there are three small square stone houses adorned with flags and streamers; there three lamas are said to live, leading the life of semi-recluses. Their dwellings look like swallows' nests plastered against the rocky wall high up above the valley. A little way past Samkang the valley widens out. We thus left the striking, accentuated breach behind us. The slope grew more gentle; the stream was frozen, and having spread out in ice-sheets, made the valley look bigger than it really is. As an actual fact the volume did not amount to very much more than 1 cub.m. in the second, and of this a large proportion came from a copious spring on the right side of the valley just above the sharp elbow. We then travelled north-west again, and soon came out upon the level plain of Tanksi, with houses of stone and clay, small clumps of willows, and cultivated fields surrounded by stone walls. On the left we passed the outlet of a large glen, through which a path is said to lead to Rudok. In the expansive outlet of our valley several bosses of schist stand out separately and detached. One of them is crowned by the monastery of Dschova, occupying a picturesque and commanding position on the summit of the naked pinnacled crags. On a couple of other isolated crags in the vicinity stand a red four-square building and a similar tower respectively.

After changing horses at Tanksi, we rode on down the broad valley, keeping beside the river, which has high scarped banks, that on the left being the more powerfully developed. On the way we passed several houses and steadings, cultivated fields, canals, and peasants. We were now amongst a different people, the Ladakis. All the way down *manes*, or religious stone kists, were common, some of them as much as 80 m. long. They are built up as cyclopean walls, and form long, narrow oblong spaces, filled with gravel and clay, the top of which is somewhat arched or broken. Upon these rest the sculptured stone slabs, the sacred inscriptions on which are often executed with extraordinary skill and taste.

After passing the villages of Pungpung and Lakang, we at length reached Drugub, where we crossed the river by a picturesque bridge, made of long tree-trunks resting on stone kists, the interspaces being filled in with flat slabs. The village itself is a wretched place, but owing to its situation is not without importance, for from it a road starts for East Turkestan. Here, pretty high up on the left side of the valley is a simple station-house, which commands an imposing view of this magnificent region. The altitude above sea-level is 3900 m., but the station stands fully 50 m. above the bottom of the valley.

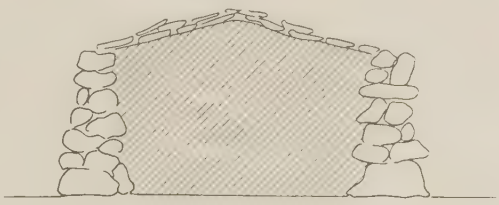


Fig. 273.

On the 18th December, accompanied by two attendants, I rode over the lofty and very toilsome pass of Tschang-la. In the early morning the valley of Tanksi, at any rate its lower end near Drugub, was closely wrapped in mist, and magnificent and sublime though the valley was, the icy coldness of the air chilled us to the bone. The weather however continued first-rate, and in no way interfered with our climb over the pass. Except for about an hour when the pass was enveloped in threatening snow-clouds, the sky was bright.

From the station-house of Drugub we took a shortcut, very steep, up the slopes on the left side of the valley so as to cross over the sharpened spur which separates the valley of Tanksi from the glen that leads down from the pass. At first we picked our way through deep ravines, fissures, and watercourses, choked with stones, and having difficult gravelly bottoms, and when we at length got clear of their labyrinths, we emerged upon slopes which were not only less steep, but also less gravelly, and in part covered with soft soil. For a while we had the stream of Drugub far down below us, but after that it was screened from our sight. Once we had surmounted the culminating point of this bold headland, we found at our feet the deeply carved, tunnel-like gorge that leads down from the pass. It too is choked with gravel and stones. At length we reached the bottom of the new glen, striking it at a place called Tschang-la-dogbo, where a group of stone-walls on the left-hand side betrayed the presence of cultivated fields. There too the bottom of the glen was entirely occupied with large sheets of ice, which came from a spring close by. Below that point the glen is said to be impassable, owing to fragments of rock and the narrowness of the passage-way. The brook down from the pass unites with that from

Tanksi, and then under the name of Schejok continues north, piercing through the granite in a glen which we shall learn something more about presently. The range in which the Tschang-la is situated separates the Indus from its tributary the Schejok, and it too consists for the most part of granite. The country thereabouts is colourless — grey — grey, nothing but stone, and only in part covered with snow, and even then only thinly.

Fig. 274. INHABITANTS OF DRUGUB.

The road ran next along the foot of the slopes on the left-hand side of the valley, keeping on the top of the eroded scarp, generally at no great height above the bottom of the glen; indeed we repeatedly came into contact with the ice-sheet that filled the watercourse. Just below Tschag-nagbo, an expansion of the glen with a couple of stone huts, we crossed over a swelling on its right flank. At this place again there are springs, and they had formed long ice-sheets. After a long climb up the terraces on the left side of the glen, we at length reached an obo in the district known as Tsoltag. The superficial configuration here gave rise to an illusion; for when we thought we had only a short distance left to the pass, it turned out that we had still a good long way to go, and that the pass was hidden behind the mountain-masses which rose on our left. So up, up we still continued to climb; but though the way was long, it was easy, sometimes almost horizontal. In the locality of Mokar the glen widens out into a broad, relatively flat gathering-basin, upon which the eroded watercourses of all the surrounding mountains converge. Several of these, especially on our right (*i. e.* the left-hand side of the glen) are remarkably large. On the same side the summits of the mountains were capped with snow. The mountains on our left (right side of glen) were however nearer to us, and we had a good view of their bold and picturesque sculpturing. We were then travelling west-south-west. In two or three places we passed immense sheets

THE TEMPLE OF TIKSE.

of ice, bright as glass and with a greenish tinge; they were formed by spring-water. At length we turned to the south-south-west, and so came within sight of the acclivity leading up to the Tschang-la. The pass is a gap in the range which we had hitherto had on our left hand, and forms a gateway, into which we entered. The ascent is very steep, and difficult, because of the stones and débris that litter it. The acclivity does not lead straight up to the pass, but is divided into a series of steps or terraces, each successive step consisting of a vast scree of stones.

Fig. 275. A TSCHORTEN AT DRUGUB.

At length we reached the summit of the pass, indicated by a cairn of stones, with poles, horns, and rags. According to my observation, the altitude amounted to 5360 m. At that time the sky was more than half covered with clouds, the wind was blowing from the south, the temperature was — 16.1°. This pass was therefore one of the very highest that we had crossed over on the Tibetan highlands, and much more toilsome than any that we had had to deal with in Tibet proper, though this was due not so much to the altitude as to the long upward climb and the in part difficult character of the ascent. From Drugub we had ascended not less than 1460 m., no light matter considering how high up we were to start with.

The descent from the pass towards the south and south-west is remarkably steep, the path zigzagging backwards and forwards down the face of the cliffs and repeatedly crossing over the brook that courses down from the pass. After that we kept to the left side of the glen, leaving a solitary house on our left hand. A little below it is a small open expansion of the glen, resembling a platform, and known as Singrul. There a side-glen comes in from the left, which is said to lead to Tanksi, but to be practicable for foot-passengers only. In this part of the glen there is a powerful spring, which had given rise to gigantic sheets of ice; these we had for a space close on our right hand. Between us and the watercourse that runs

down from the pass another steep, subsidiary spur had however intruded itself; it really forms the continuation of the end of the crest which separates the pass glen from the glen which leads to Tanksi, but they unite soon afterwards. At Singrul we were at an altitude of 4898 m., and thence we descended rapidly to still lower regions, by following the left slope of the united glen; the path, very steep, gravelly, and difficult, runs high up above the bottom of the glen. Upon reaching the outlet of a side-glen on the left we once more went down to the bottom of the main glen, doubled a bluff, and so reached the station-house and village of Tagar, consisting of ten or a dozen houses. Since leaving Singrul we had descended a good 1000 m.

Fig. 276. DSCHIMRE.

On 19th December we continued our ride down the glen, keeping mostly to its left side, or rather on the left bank of its gradually increasing stream. Until we reached Dschimre the path was very stony, though from there it gradually improves, and is better cared for in consequence of the greater amount of traffic. We constantly passed houses, steadings, and cultivated fields. The next village that we came to was Sakti. At Dablung we passed a little frozen brook that issued from springs on the left side of the glen. On the right our glen was joined by an especially large side-glen, higher up in which stands the monastery of Dschagtak-gompa. This latter glen leads on farther to the pass of Varis-la, over on the other side of which lies the village called Tschema-tschungru. The religious stone-kists now became increasingly more numerous; in fact they form quite the characteristic feature of this route, as well as afforded me a fresh interest. Ladak is indeed the land of stone kists; nowhere in Tibet are they so numerous as here. One of the first of the larger type that we encountered measured 260 m. in length and the whole of its surface was covered with slabs of stone, all inscribed with the usual precatory formula. Fortunately for the monks who build up these votive monuments, they

have not very far to go to get their materials, neither the larger blocks of stone, nor the thin slabs of slate. These stone kists are always erected in the vicinity of a monastery or temple. So here: above the long village of Dschimre, straggling along the bottom of the valley, with its cultivated fields, its orchards, and its rows of willow and poplar trees, the monastery of the same name, Dschimre-gompa, crowns the summit of a dominating crag. On the west side of the bluff are several houses, the dwelling-places of the lamas, clinging like swallows' nests to the face of the cliffs.

Fig. 277. THE FRONT OF TIKSE-GOMPA.

Here the glen is, I dare say, 2 km. broad, and is joined by several spring-fed streams. The mountains on both sides are still of great size, although gradually decreasing in altitude as they approach the Indus. There was however but a trifling quantity of snow on them; in fact everywhere, all the way to Srinagar and Murri, there was reported to be exceptionally little snow that winter. The pass of Tschang-la is generally wont to be so blocked with snow in the beginning of December as to be absolutely impassable; but we had found it practicably free, except that there was a patch a foot deep just under the summit of the pass on the south side, and snow also filled the interstices between the stones, but before we reached Tagar it had quite ceased. When we returned by that same route in April there was a greater quantity of snow on the Tschang-la.

A short distance below the temple we crossed over the now not inconsiderable river, and its energetically excavated bed. The bridge is constructed of logs in a single span, and looks anything but safe. But at that season we could easily ride across the river-bed itself, for it was half filled with sheets of ice. In the neighbourhood of the river-mouth, on its left side, stand the villages of Karru, Sabdschek, and Do. After doubling a granite spur on our right, we debouched upon the broad

valley of the Indus, whereupon the country as a whole widens out to grandiose dimensions. When we first caught sight of it, the great river was flowing from the S. 25° E.

Wheeling round the bluff that separates the side-glen from the principal valley, we travelled down the latter on the right bank of the Indus. At the angle of the road, and almost opposite the bridge across the Indus, there are two immense stone kists, one 250 m., the other 420 m. long, about 6 m. broad, and 2 to 3 m. high. We also observed several stone kists on the opposite or left side of the valley, beside a flat gravelly scree at the outlet of a narrow transverse glen. In this valley stands the temple village of Hemi. Marschang, Mangaltschak, and Dschanga

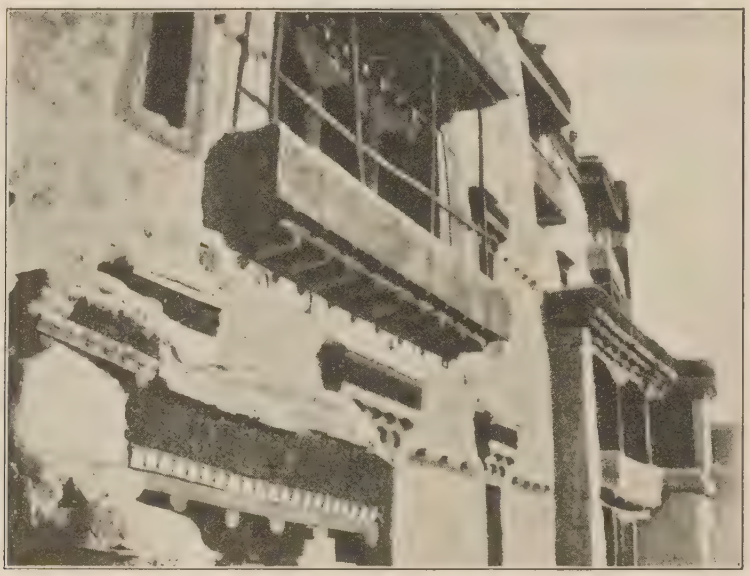


Fig. 278. DETAIL OF THE SAME.

are the names of villages on the left bank of the river. The bed of the stream is there very deep, 40 to 50 m. down, and its eroded escarpments are built up entirely of gravel-and-shingle and pebbles. Estimating by the eye, the volume would be then about 10 to 15 cub.m. in the second, and the water was perfectly transparent, so that almost everywhere, where it was not too deep, we were able to discern the gravel and stones at the bottom. The fall is so great that almost all the way along the river forms cataracts. Nevertheless narrow ribbons of ice had succeeded in forming along the banks, though only in places in which there was no current. The whole of the stream was collected into a sharply defined and very distinct channel, and the alluvial deposits, which are only covered at high water, were exceedingly narrow. At wide intervals tiny alluvial islands, oblong in shape, projected above the water, and were generally covered with snow. The fact of their occurring just where they do is clearly due to the protection afforded by the deep bed of the river, because the country on both banks is bare.

In point of volume the Indus was nearly the reverse of impressive, and I confess I was almost disappointed, having expected to find a vast stream. But then I called to mind the season of the year, the absolute altitude at which we actually

Fig. 279. COURT-YARD OF TIKSE-GOMPA.

Fig. 280. THE SAME.

were, and the circumstance that the river is not joined by its great tributaries until it gets farther down, and I realised that there existed no grounds for disappointment. Besides, the shape of the river-bed alone bears eloquent testimony to its

history, showing that during the summer the river must swell to very respectable dimensions. In consequence of the shape of the bed the breadth does not increase very much at the point in question; but on the other hand the depth and the velocity both increase all the more. At the same time it is amazing how the bridges, both here and lower down, considering their fragile construction, are able to withstand the pressure of the summer flood.

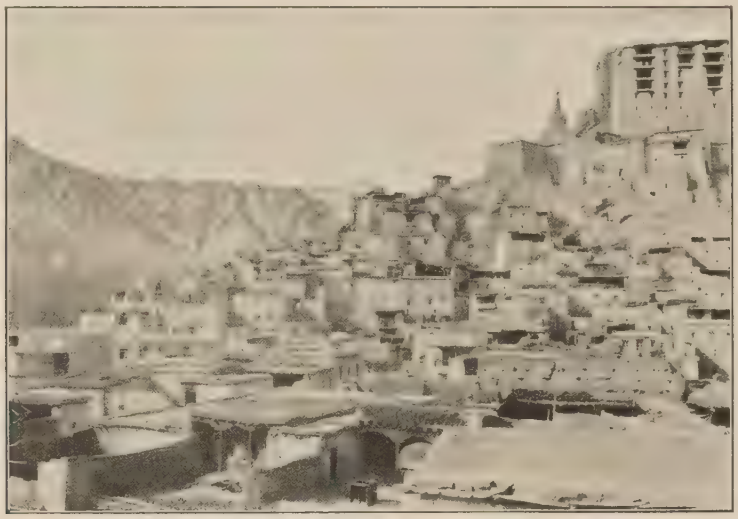


Fig. 281. LEH.

We travelled, then, along the right bank of the Indus, and soon came to a bend, in which the stream was dashing itself with a hollow roar against the almost vertical cliffs; but round this buttress an excellent road has been made at about 20 m. above the river. The erosion terraces on the left bank make sombre shelves, almost wearying in their uniformity; along the flank of the lowest of these terraces runs an irrigation canal, which carries the water up to the top of the terraces and then irrigates the fields around the villages lower down. The mountains on the left side of the river stand a considerable distance back from it. So far as it was possible to judge at a distance, the rocks there appeared to dip 35° to 40° towards the S. 40° W., and owing to the strips of snow which still lay on the outcrops of the strata, the positions of these were well defined.

The valley expands, the mountains on the right also receding a little, and we entered upon a broad, open plain, paved with sandy soil, hard, level, and first-rate for riding on. We passed the villages of Sassoma and Nang; the villages on the left side of the river are more numerous, one of them is called Mato. On our left we passed two detached rocky knolls, rising above the otherwise level expanse; the one farther away was crowned by the temple of Tagsu-gompa. After that came the large, straggling village of Tikse, with its houses and steadings, its sacred stone kists and *tschortens* indicating the proximity of a temple. In the background the temple of Tikse crowns the top of a projecting headland, and the 40 or 50 lamas

that belong to it have their dwellings at the foot of the cliff, though some of them live up in the temple. I paid the latter a hurried visit. The view of the Indus valley from the roof and balconies of the temple is magnificent. The accompanying photographs (figs 277—280) will give some idea of this peculiar temple complex, though it is in no way different from all similar groups of buildings in Tibet and Ladak. The station-house of Tikse lies 3317 m. above sea-level.

Fig. 282. A GATEWAY OF TIKSE-GOMPA.

Of the last day's ride to Leh there is not much to relate. We again turned away from the Indus, and climbed up the broad sloping expanse or widening of the valley on the right of the great river. Upon it a great number of smaller glens debouch; and along it rise various more or less detached chains of heights and small buttes. The country thereabouts is almost barren and desolate, and conveys the impression of being half a desert; the ground is strewn with gravel. The stone kists are of amazing dimensions; in fact they look like long walls skirting the wayside. At length, after passing through the last little rocky gateway, we caught sight of the castle of Leh, crowning a dominating crag, and at its foot nestles the little town with its labyrinth of houses and courtyards, its long bazaar street, and its avenues of poplar trees. The town lies at an altitude of 3506 m.; consequently we had climbed up nearly 200 m. since leaving Tikse, which itself lies very little above the Indus.

For the next three and a half months Leh was my base of operations. Leaving there my caravan, my attendants, and my baggage during the winter and spring, I myself paid a short visit to India. During my absence the Cossacks continued to take meteorological observations; these have been studied by Dr. Ekholm, and are printed in the Meteorological Section of this work. During my run down into India,

I did not myself take any observations, at all events I took none regularly, nor did I draw any map of the road; for in the first place I looked upon the trip in the light of a well-earned holiday, and in the second I travelled by a well-known route, which, together with the adjacent country, has been already mapped and examined in detail. Nevertheless I venture to add a few words about the road to Srinagar, so that I may give at least some idea of the region that serves as the transition from the Tibetan highlands to the deeply excavated, and with respect to their vertical relief, the so energetically sculptured glens and valleys on the southern face of the Himalayas. Whilst we were still within the inland-drainage regions of western Tibet we had come across anticipations of the transition from the plateau-like high-

Fig. 283. THE INDUS VALLEY AS SEEN FROM THE ROOF OF THE TEMPLE OF TIKSE.

lands to the morphology of the peripheral regions. We encountered evidences of it in the valley of the Tsanger-schar and after that in the bigger valley, fenced in with immense mountain-masses, that contains the lakes of Tso-ngombo and Panggong-tso. But we came to the first really definitely indicated boundary between the two types of country at the low threshold that parts the drainage-basin of the Panggong-tso from that of the Schejok river; for it was there that we left behind us the inland-drainage areas of Tibet, indeed the vast self-contained drainage-region of Central Asia, where all the products of disintegration and denudation, and all the sedimentary material that results, are retained in the interior of the continent, and there too we set first foot upon the peripheral regions which possess an outlet to the Indian Ocean. The second well-defined boundary that we passed was the pass of Tschang-la. This belongs, it is true, to the peripheral zone, but nevertheless it had to be climbed over in consequence of the configuration of the country. In any case, it certainly constitutes an important dividing-line. To the east of it we found only

A STONE KIST NEAR LEH.

Ljustr. A. B. Lagrelius & Westphal.

A TSCHORTEN (CHORTEN).

Tanksi, Drugub, and one or two other insignificant villages; to the west of it the mountainous country from Dschimre onwards is relatively thickly inhabited, with fields and orchards and plantations of trees.

Fig. 284. OUR LAST NINE SURVIVING CAMELS AT LEH.

It is solely for the purpose of recalling in this connection the third important boundary on the way between Tibet and India, namely the pass of Sodschi(Zoji)-la that I will, in the briefest terms, recapitulate the most prominent features the road between Leh and Srinagar.

CHAPTER XXIII.

FROM LEH TO RAWAL-PINDI.

On the 1st January 1902 I left Leh, attended by one Cossack, and some Ladakis, and a troop of horses, which we continued to change at each succeeding station. The distance between the two towns Leh and Srinagar amounts to 242 miles, little more than 400 km., and is divided into 17 stages, all of them at villages

Fig. 285. TSCHORTENS AT LEH.

except the stations nearest the pass. At each station there is a »dag bungalow», or guest-house, generally furnished in a practical and comfortable way. The whole organisation of the road is, or was, very similar to the »tschapari» system that obtains in Persia. Every station has a certain number of horses for the use of travellers at certain fixed rates, so that you can travel as rapidly as you please. The native authorities in the villages are responsible for looking after the roads and keeping them in good repair. To one travelling up to Leh from India it must be a tire-

some and trying journey; but to me coming as I did from the desolate, wild, and inhospitable regions of Tibet, the road down to Srinagar appeared to be the height of luxury.

The first station on the route to Srinagar is Niemo. At first the road runs south-west down to the Indus, the ground sloping very appreciably and the slopes being thickly strewn with granite fragments and detritus; but a track about 3 m. broad is kept relatively level between two rows of stones. Thence to its broad outlet the valley is barren and desolate. At the point where we struck the river we passed on the left a small detached knoll, with a temple on the top. According to the English map the place is called Pittuk. After that the road runs west-north-west alongside the river, though this soon becomes lost to sight in a deep gorge and at the same time keeps a more westerly course. The road meanwhile follows the foot of the mountains on the right side of the valley, the surface being undulating, gravelly, and barren, with only one or two inhabited localities. Out of the side-glens issues an occasional brook, in every case spanned by a bridge of logs on stones. At these places there is generally a small orchard. The water from

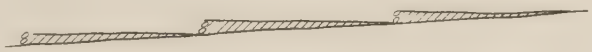


Fig. 286.

these brooks was then frozen into large ice-sheets, though there was always an open current running through the middle of them. Then we rode upwards for a good distance until we reached a little threshold in the continuation of an offshoot of the mountains. Over on the west side we went down through a steep, wild ravine or gorge, carved in gravel-and-shingle of immense thickness, and terminating in a fresh side-glen, with a brook at the bottom of a deep watercourse. Stone kists and *tschortens* were common here also, though in point of size not to be compared with those which we had encountered on the Tibetan side of Leh. After that we came to the orchards and fields of Niemo, situated quite close to the right bank of the Indus. It is there that the large tributary of Zaskar joins the Indus. At this part the principal valley is somewhat narrower than hitherto. Its scenery is decidedly grand, and one cannot but be amazed at the vast energy with which the incessantly active stream has wrought in excavating its bed. The ancient scarped terraces are of enormous dimensions, and often show on the crests of the mountains behind them. Not infrequently however these great scarps are pierced by the outlets of the glens or interrupted by gravelly screes working their way out of fissures in the mountain-sides. Owing to the steep slope of the valley towards the west the fields are also to some extent arranged in terrace fashion. A piece of cultivated ground that runs for 100 m. in the direction of the river may at its lower end be only 2 or 3 m. above the bottom of the valley. It is held up by a stone wall, inside which the earth is banked up, this arrangement being necessary in order to distribute the irrigation water over the fields. During the course of the day we observed antelopes, partridges, and wild-duck. At Leh there was no snow at all, but around Niemo it

lay in thin patches. The adjacent mountains were for the most part whitened over. The English map calls the station Snemo, though to an adjacent ridge it gives the name of Nimo.

The goal of the second day's journey was Nurla, called on the English map Snurla. After riding beside the Indus for an hour or so, we lost sight of it after it made a bend to the south, and rode up to the village of Besgo, situated in the outlet of a side-glen on the right. This glen, which is not very big, starts from the top of the main range that separates the Indus from the Schejok, but it is more thickly inhabited than any other glen in that region, the villages lying quite close together. For a short distance the mountainous country on our right was fashioned into the most fantastic shapes. The rock was red sandstone and conglomerate, and that relatively soft material has been weathered into an endless number of columns and sharp-pointed pyramids, standing as close together as the trees in a forest. Sometimes a small block of stone crowns the top of one of the pyramids, though they have for the most part fallen down. It is however plain, that it is to these protective cappings that the columns owe their origin. In consequence of these conformations the road looked in places dangerous, the stones appearing ready to fall at any moment.

After crossing a little bridge, that spans a brook issuing out of a minor side-glen, the road ascends rather steeply by zigzags, but then keeps for a good distance at the same horizontal level, possibly along the top of an old escarpment or riparian terrace. Here again we crossed over a minor offshoot of the main range. On the right a track branches off for Nurla by way of the village of Liker and for other places in the transverse glens. Then we crossed over yet another little pass, the rock at which was schist. After that we went down again by a zigzag path until we reached the outlet of a larger glen with a brook and a permanent bridge. Thus there exist a whole succession of side-glens opening on the right of the road, though from the left there are practically none. In an expansion of the Indus valley, not particularly wide, stands the village of Saspul; its fields are arranged in the usual terraced fashion, built up as it were on platforms (fig. 286). Apple, apricot, and other fruittrees abound, but the predominating tree is the poplar. The village occupies a splendid position on the slope, fully exposed to the midday sun. On the opposite or left side of the Indus steep cliffs overhang the river, and flat, level expanses occur but seldom. Just below Saspul we got close down to the Indus. There the river was crossed by a bridge, consisting of tree trunks cleverly thrown across from two small rocky headlands projecting into the stream, or rather they are the two halves of a threshold or sill, through which the river has sawn a passage. Nevertheless it appeared to me, that a certain amount of courage would be required to entrust oneself to such a fragile structure. The place is known as Altschi-samba.

On the mountain-slopes on the left side of the river we observed three terraces of an altogether remarkable size, the highest being, I dare say, 400 or 500 m. above the bottom of the valley. Along that side of the river there is also a path, which however appears to be used for local traffic only. The chief highway runs along the right side of the Indus, forming as it were a shelf or cornice on the flank of the mountains, generally at about 40 to 50 m. above the level of the stream.

The scenery was fascinating, the views succeeding one another with bewildering frequency; it was grand! I can hardly remember having seen more magnificent scenery than that of this upper valley of the Indus. The powers of nature which are unceasingly at work reshaping and remodelling the crust of the earth have here effected results of a truly amazing character. Everything is on the grand scale, the chiselling of the mountains being in ampler proportions than one is wont to find elsewhere. The vertical differences of altitude within a short distance, the principal valley, its side-glens, the offshoots of the mountains, the ancient scarped terraces that overhang the river — all are of gigantic dimensions. But it is in sooth a powerful river that courses down the valley: it is it which is the determining factor, which gives shape and form to all the other geographical features within reach of its influence. From the road, then, we saw the river below us, stretched out as it were on a map and had an excellent opportunity to observe its ribbon of bright green water, tolerably uniform in breadth, clasped between the belts of ice, of varying breadth, that lined it on each side. Where the river is broad and the current slow, we could distinctly see the bottom, which was filled sometimes with gravel, sometimes with rounded blocks of granite. One while the river is broad and deep, and the current glides along noiselessly as if it were oil; at another time it contracts, and the water rushes foaming and boiling amongst the big stones of a cataract. Occasionally it was so expansive and moved so slowly, that it was frozen all the way across and on the ice lay a thin covering of snow. In several places the ice was strong enough to bear men on foot, and even asses, and at intervals we saw how the people do use temporary winter tracks across the great river. The frost had even seized upon the stream itself at some of the narrow bends, despite the rather swift current; this was because at those places it lay perpetually in the shade. Along the surface danced the ice that rose from the bottom in round slushy patches, which dived cleverly in under the ice-bridges, and then jauntily emerged again at their lower side. The water was so transparent that in the open, sunlit reaches of the stream we could clearly distinguish the shadows of these floating patches of ice on the bottom of the river.

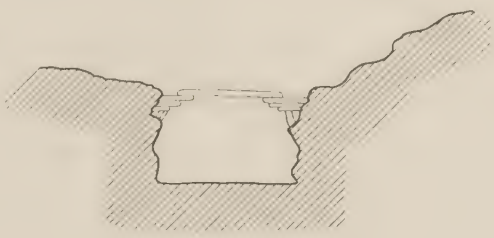


Fig. 287.

But the valley of the Indus soon began to grow increasingly narrower, wilder, and more picturesque, and at the village of Lardo it contracts to an especially confined gorge. In a small expansion on the right bank stands the village of Uletoklo, and on the same bank, though not visible from the road, is the temple of Risang-gompa.

In this part of its course the Indus hugs closely the left side of its valley, where the cliffs are so steep that it is only here and there, especially in the outlets of the smaller side-glens, that they leave room for a tiny village or a few homesteads. For a space the river is very broad, almost like a long, narrow lake, out of which it issues at the lower end once more compressed and churned into foam.

In several places it is encroached upon at the sides by gigantic screes of fragments of granite. On the right comes a narrow and picturesque side-glen, opening through a rocky portal, and across its brook the road is carried on another bridge. The green and violet schists in this region are generally »veneered» with a crust or layer of a hard consistency, brown in colour and glistening. At the height of 30 to 40 m. above the bottom of the valley we frequently observed excavations, more or less shallow, in the face of the solid rock, and signs of aqueous wearing when the stream flowed at the higher level. In the gravel-and-shingle walls on the left side of the river there occur not seldom a species of »giant pot-holes,» that is to say, hollows in the soft material, with a large water-worn block of stone in the middle. It is quite evident that these stones lie *in situ*, as also that the pot-holes themselves have been caused by the gyrating and churning action of the water in the eddies during the high-flood period. At that time, when the river was low, these stones were motionless and even half buried in the mud, which has subsequently settled in the hole, partly filling it up.

Fig. 288.

From the left comes the deep-cut, but short, glen of Hipti, in which a couple of villages are situated. All the way from Saspul the valley is confined and picturesque, and the road has been made, not without toil and trouble, along the rocky slopes, following their every irregularity, projecting elbows, ravines, and side-glens. Sometimes it climbs upwards round a steep place, sometimes it dips down into a transverse glen, and then up again to the next spur. In crossing a gorge, the down-flowing rainwater of which may imperil the road, it is artificially arched, so that it resembles a bridge and is separated from the cliff by an intervening space, and the tunnel underneath the arch serves for the passage of the water and any detritus it may carry with it (fig. 288). The walls of these independent bridge-like structures are often very high, especially on the outside, and the stones of which they are built are of great size and placed carefully one upon the other. In other places, especially where it runs along the steep rocky slopes, the road is often so narrow that it is impossible for two travellers to pass one another, and just before coming to these places it is customary to send a man on ahead to keep the road clear. At Pulung-jungjung there is on the right bank a peculiar, pyramidal rocky butte, quite detached and looking like a tower built by human hands. At that spot the river makes a sharp turn to the left, and then for a long distance it was free from both ice and snow, which greatly impaired the picturesqueness of effect, for it made the bottom of the valley appear monotonous and as if it contained no water; besides, the lively babble of the current was no longer audible. At Bahan-tang the Indus valley is joined by the upper route from Besgo that I have already mentioned. The village of Nurla is situated at a very confined part of the valley; there however the stream, in consequence of its rapid fall and cataractal character, was again destitute of ice.

The station-house stands close beside the river in a position which for picturesque beauty is quite unique.

From Nurla to Kalatschi the character of the scenery does not alter; the valley still continues to be narrow, and the road keeps to the steep slopes on the right. The deep shade which prevailed in the early morning to a great extent blurred the outlines of the relief. But after the sun had risen and lit up a portion of the right side of the valley, the wild and gigantic surface-forms stood out with great boldness and emphasis; but down in the bottom it was as cold and clammy as in a cellar. The patches of drift-ice on the river had increased in size. Now they swept in long connected files along the front of the ice anchored to the banks; now they crumbled to pieces upon getting caught in currents of varying velocities; and sometimes they stood still, piled themselves up one upon the other, and swung round in the eddies.

The village of Kalatschi occupies a picturesque and attractive position, and its grey stone walls, rising amphitheatre-wise one behind the other, make an apt background for the poplars and fruit-trees. Upon leaving the village the road goes down to the Indus, past the steadings and balconies and roofs of a white-walled watch-house. At the spot where the bridge spans it, the river is very narrow, being compressed between two rocky thresholds one on each side. The bridge rests upon stone supports at each end and is built of long logs of wood, with planks laid across them. It measures 36 paces or 25 m. in length. A second, but smaller, bridge crosses over a side-arm a few meters from the Indus. Not only was the bottom of the latter just then dry, but it was actually a good 8 m. above the level of the principal river. Probably a portion of the stream will flow along that arm in the flood season. The great difference in elevation bears however eloquent testimony to the enormous erosive energy that is developed in the principal bed, where the river has eaten its way down with such force that the side-branch has been unable to keep pace with it.

After that the road follows the left bank of the river, though at some distance from it; but very soon we turned our backs altogether upon the valley of the Indus and entered a side-glen. In this we encountered a succession of views of the wildest and most magnificent character. The glen itself is sawn down to an unparalleled depth between perpendicular walls of naked rock, for the most part black schists. The bed of the watercourse at the bottom of the glen is about 15 m. deep and has vertical escarpments, these too for the most part bare rock, namely black schist. The road kept to the right side of the glen until we reached the elastic and swinging bridge of Hlangtschu. On the English map the place is called Hangroo; but I am not able to say which is the correct spelling, this way or the way I have spelled it. I have always made it a rule to write names phonetically; but the English topographers no doubt had natives with them who were well acquainted with the locality and with its nomenclature. Like the English map, I am unable to give the name of the glen itself. In the lower part of the glen the road runs across steep gravelly screes, but above the bridge the glen grows narrower and wilder, being sometimes not more than ten or a dozen meters wide. In some places the rocky walls overhang, and you ride under a roof and projecting eaves, and have to

keep a watchful eye lest you strike your head above. The accompanying profile (fig. 289) shows a typical portion of this road hewn out of the mountain-side, sometimes high above the bottom of the glen, sometimes quite low down. On the whole it resembles a cyclopean wall, which with a little support in this or the other fissure leans in towards the rocky precipice, and again and again you are amazed that the whole structure did not long ago tumble into the glen below. Higher up the rocky precipices are such that the construction of a similar road to this is impossible. If supporting walls were built low down near the bottom of the glen, they would be washed away by the summer floods, which evidently race down to the Indus through this glen with torrential violence; while higher up no road could be made without blasting the rock, a work that would entail great expense.

Fig. 289.

It is for this reason that the road crosses over the river four times on bridges placed quite close together. One of these was not considered safe, so that we preferred to ride across in the bed of the stream, where there was at that time no great quantity of water. Near the third bridge, Sampa-nesrak, there is a spring, which had given rise to a big lump of ice. At Sumdo the glen divides, that is to say, we turned out of the main glen to the right and proceeded up a side-glen, in which Lama-juru is situated. At the point of bifurcation a clump of poplars was growing. The scenery there is in the highest degree magnificent. The echoes rang against the vertical walls of rock, and we rode to the accompaniment of a hollow murmur from the stream. In fact, it was like riding through a magic temple, with walls of living stone.

In the side-glen up which we turned there was but a tiny muddy brook, though its bottom contained a great number of ice-sheets, mantled with snow. At this part the road grows very tiring, because not only does it take advantage of favourable buttresses of the cliffs, and so winds up to a considerable height above the bottom of the glen, but it also sinks down again to the water's edge, and we frequently crossed the brook on the ice. In two places, first on the left side of the glen, then on the right, we had to scramble up a steep zigzag to the heights above, owing to the glen being too narrow to admit of the passage of the road; besides which it is completely choked with gravel and stones that have fallen from above. The places from which these rock-slides started are distinctly visible fully 800 m. above the existing bottom of the glen. At the second of these two defiles the glen looks like a mere fissure with perpendicular walls, and it was perfectly obvious that even men on foot would not be able to advance along it in that part. After working our way up over the steep but more gently rounded heights on the left side of the valley, we reached the expansion of the glen in which the monastery of Lama-juru is situated. Its various buildings cluster like swallows' nests on the top of a precipitous terrace of gravel-and-shingle.

On the 4th January, I covered the stage to Mulbek, crossing on the way over two great spurs of the main range which overlooks the principal valley of the Indus on the south. The ascent from Lama-juru up to the first pass, Fotu-la, is not particularly steep, though you distinctly feel it. According to the English map the

UP TO DRAS.

NEAR SONAMARG.

village lies at an altitude of 11,240 feet and the pass at 13,456 feet, so that the difference of altitude is not far short of 700 m. The higher we climbed the greater grew the quantity of snow, until finally it formed a continuous sheet, though it was not at all thick. The brook that runs down from the pass was frozen into big sheets of ice occupying a large portion of the bottom of the glen. As we approached the top, we found that the relative altitude decreased and the scenery grew relatively tamer, while up on the top the country was leveller. The actual pass itself is gently rounded and marked with a cairn of stones. Thence the road slopes

Fig. 290. TSCHORTENS AT LAMA-JURU.

beside the brook uniformly down to Karbu, being often pretty high above the floor of the valley; but at the outlet of every side-glen it dips down into the bottom, and climbs just as steeply up again on the other side. We passed several other villages. After leaving Karbu the road continues for a space on the left side of the river, which is called on the English map Saneeloomak, and empties itself into the Indus. Between its right bank and the left bank of the Indus rises the mountain-chain which we had just crossed over by the Fotu-la, unless indeed we ought not rather to look upon this pass as being situated on a transverse col connecting that chain (which runs parallel to the Indus) and the loftier glacier-crowned range which lies to the south of it. We then made our way up a little side-glen to the pass of Namika-la (13,008 feet) in the next subsidiary chain. There the snow was more abundant than on the Fotu-la. Thence it is no great distance down to Mulbek, which lies on the river Wakkha, an affluent of the Suru, which itself is a tributary of the Indus.

The next day took us down the glen of the Wakkha to Kärgil (Kurgil), the only change in the scenery being that the glen grew more accentuated the farther we advanced down it. At Kärgil, which is an important village, with relatively rich cultivation, we were again in the midst of immense, grandiose mountains, surrounding us on every side. The river there, after its junction with the Suru, makes a pretty large stream, even in winter, and it would not be quite easy to cross over it without the wooden bridge, for which however an iron bridge was just then being substituted. In the summer it makes quite an imposing river, and especially a little lower down, after it has been joined by the united Dras and Shingo. In fact all the watercourses exhibit the most palpable evidences of a very lively erosive activity,

Fig. 291. SOME OTHER TSCHORTENS.

such as can only be produced by immense volumes of water. The sight of tributaries of this character, and the reflection that these are only a very few out of the vast number which enter the Indus from both sides, suggest some idea of the enormous dimensions to which that river must swell in the summer. Here we have in emphasised relief all the essential characteristics of the peripheral region. The country which we had then reached is the recipient of an incomparably greater abundance of rainfall than the relatively flat and protected highlands of Tibet. Here too aqueous erosion has given rise to a morphology in the vertical which has little in common with that of high Tibet, with its small and insignificant streams terminating in flat salt-basins, its filled-up valleys and depressions, and its levelled-down mountains.

The valleys of the rivers Suru and Dras are separated from one another by an immense mountain-spur, on the flank of which the road runs as far as Karbu. After that it continues downwards some way until it reaches the confluence, and

upon reaching that point, we left the road to Skardu and ascended the valley of the Dras, which is deep and large, and traversed by a considerable body of water, though it was then in great part frozen. Generally the snow continued to increase in amount, and went on steadily increasing until we reached the Sodschi-la, although

Fig. 292. GROUPS OF MY LADAKI COOLIES.

this pass is a good deal lower than the two that I have already mentioned. The road again runs like a shelf on the side of the slope, and was in so far difficult and tiring that it was covered with hard-trodden snow, as slippery as ice. Here and there on the slope stands an occasional coniferous tree, though quite stunted in

growth. Owing to the junction of the routes from Kärgil and Skardu on the one hand and from Srinagar on the other, the traffic was becoming more lively.

On the 7th January we travelled up to Dras. At first we kept to the right bank, though afterwards to the left. Almost the whole of the way we marched more or less high above the glen, and only very seldom in its bottom, except higher up where the relative altitudes are less. The conifers soon ceased again; thus there are but few, at all events in this locality, that have been able to get beyond the climatic and vegetable boundary set by the Sodschi-la. Down beside the river there is occasionally a bush or two. By this the snow was so universal and so deep that everything was white, except solitary stones and the perpendicular

Fig. 293. UP TO THE SODSCHI-LA, MARCH 1902.

faces of the cliffs. At the same time the quantity of ice in the river increased, though the monotonous murmur of the stream was always audible. In several places in the river-bed there were picturesque ice formations; and the water flowed on over the bottom ice between the stones as bright as crystal and of a light green tint. Generally however the ice stretched across from stone to stone, forming roofs and tabular masses, under which the stream poured with a metallic bubbling echo. In some of the open reaches the river actually smoked, steam rising from it as from warm water. Possibly this was due to relatively warm springs, possibly also to the very cold current of air which we felt all day descending the glen. By 9 p.m. the temperature had fallen very nearly to 20° below zero C., and at that level it remained almost unchanged all night, the minimum reached being only —22°. It had not been so cold since we left the eastern part of the Tso-ngombo.

From the village of Dras the road ascends the glen of that name. This in the morning above the village was entirely filled with mist, caused by the steam

rising from the river, which is there open for a space. Higher up, above the locality in which the springs appeared to be situated, it was entirely frozen over and buried under snow, though its rippling could still be heard. The ascent is very gentle, and the glen opens out, at the same time becoming flatter. In places the road still runs along the side-hills, though not very far above the bottom of the glen. The springs which issue there in the bottom of the glen had given rise to big, light green sheets of ice, generally swept clean of snow. Every now and again we crossed the stream by a fresh bridge. The quantity of snow then increased so considerably that the road was like a deep trough running across it, its bottom hard and slippery owing to the trampling of horses' hoofs and travellers' feet, which made the ride both difficult and tiring. After passing the insignificant little village of Matajun, consisting of a few simple huts, we soon reached Matschui, a solid, well-built guest-house quite close to the pass, a great boon to travellers journeying along that route in winter, for they can there await a favourable opportunity for crossing over the dangerous pass of Sodschi-la. For my own part, I had nothing to complain of in this respect: I was favoured with excellent weather, a bright sky, and no wind.

Fig. 294. A REST.

On the 9th January I crossed over the pass, and found it far simpler than from the descriptions I had been led to expect, this being a consequence of the slight fall of snow that year and of the favourable weather that was then prevailing. We travelled of course the whole way on foot. You cannot cross with horses; to attempt to ride down the precipitous slope with its frozen path would have been utterly impossible. Round about the water-divide the snow lay at least 1 m. deep, and the track was trampled along the top of it. In some places the crust was sufficiently hard to bear a man on foot, but in other places the snow was so loose that we

went through. The ascent from the station up to the actual pass (alt., 11,500 feet) is very slight, scarcely noticeable, and on the other side the descent is equally gentle at first. In fact, in such a dead level of universal whiteness it was difficult to say

Fig. 295. ON THE SLOPES OF SODSCHI-LA, JANUARY 1902.

Fig. 296. ON THE SLOPES OF SODSCHI-LA, JANUARY 1902.

where the actual water-divide was situated. But it is the mountainous character of the country on the south side of the pass that makes the Sodschi-la so dreaded, and generally keeps it closed for a certain part of the winter, or at any rate makes it

extremely perilous to set foot upon it. On the west side of the water-divide the gorge down which the pass stream makes its way is fenced in on the right by the precipitous slope of a compact spur of the mountains, and along that you go for a pretty long distance. The gorge or ravine in question is carved out with unparalleled energy to a great depth. Its bottom is choked with huge fragments of stone, and in the warm season is absolutely impassable, because the flood of water is then a hindrance. In the winter it is different, especially during March and the latter part of the season, at all events it was so that year. The masses of snow which accumulate on the summit of the mountains that overhang the gorge plunge every now and again down into the depths below in the shape of immense avalanches,

Fig. 297. APPROACHING DRAS, MARCH 1902.

gradually filling it to the depth of several hundred feet from the bottom. By this means a track can be secured through the gorge. You then travel, as I did on my return journey to Leh, on the top of the fallen avalanches, although the temporary track so made is rather steep. The dangerous portion is fairly short, though quite long enough for travellers to get buried under the avalanches. The important thing is to choose a quiet time in the early morning, whilst the snowy masses are still relatively adherent in consequence of the cold during the night. In the day time, and especially when the sun is shining or the wind is blowing strong, it is extremely perilous to venture into the defile. Under such circumstances the wisest thing is just to wait. The path on the face of the precipice on the right side of the gorge is absolutely impassable in winter, for it is overhung by threatening masses of snow, which may at any and every moment start gliding downwards. In the year 1902 the track was however still passable on the 9th January, although travelling was anything but agreeable. For it was very narrow and frequently sloped outwards;

moreover it was caked with unbroken ice, formed through the freezing of the water that drops during the day from the melting snows above. In fact, it would be actually dangerous to venture on it without axes, a rope to tie you all together, and

Fig. 298. THE SAME.

Fig. 299. ON THE ROAD TO SODSCHI-LA, MARCH 1902.

trusty and vigilant guides to help you. For on your left yawns the abyss, the bottom of which you often cannot see in consequence of the precipitous character of the slope and projecting cornices that screen it from above.

BELOW SONAMARG.

ABOVE SONAMARG.

Fig. 300. THE SAME.

Fig. 301. NEAR SONAMARG.

Upon reaching the edge of the platform down the face of which the path plunges headlong to the station-house of Baltal by a series of short, quick, zigzagging turns, you involuntarily pause, lost in admiration of the view that lies spread out at your feet. In fact, I stood there a considerable time, notwithstanding the keen wind that was then blowing from the east-north-east, for the wind had been freshening up as we gradually approached the brink of the declivity. This then forms the third sharply defined dividing-line between the highlands of Tibet and the

Fig. 302. THE SAME.

Fig. 303. ON THE ROAD TO SRINAGAR, JANUARY 1902.

southern valleys of the Himalayas. Far down below our feet was the upper part of the glen which leads out upon the valley of Kaschmir. The glens of the peripheral region which we were leaving behind us are barren, or have in any case but little vegetation to show; at our feet we had a fresh gigantic valley, on the slopes of which grow coniferous forests, pointing to a milder climate and giving to the Sodschi-la the character of a climatic boundary. The descent of this steep declivity was likewise dangerous because of the frozen nature of the pass: a slip of the foot

would have been fatal. Hence it was with a feeling of relief that we at length saw the station-house of Baltal growing bigger and bigger, and still keener was our gratification when we at last found ourselves on the relatively level expansion of the valley in which the station-house stands. By the time we got down the wind was blowing quite a gale; but my guides declared it was feeble as compared with that which generally prevails every day during four months of the winter, sweeping in intermittent, but furious gusts across the pass of Sodschi-la. It is because of this violent wind that the station-house of Baltal is constructed of such very solid timbers; the beams and posts in its interior are as substantial as those in the hull of an Arctic whaler. The very telegraph poles in that locality are supported to enable them to withstand the force of the wind. The summer is however said to be free from these gusty squalls. They would seem to be in some way connected with inequalities in temperature and atmospheric pressure in the region above and below the precipitous declivity. The ground around Baltal and for some little distance down the valley is bare, this being clearly a consequence of the wind. It was not until we got farther down that we came upon the first strips and patches of snow; but before we reached Sonamarg the snow again formed a continuous covering. In that part of the valley we rode on the right bank of a not inconsiderable stream, which derives its real water-supply from a couple of side-glens that debouch from the south just below Baltal. Sonamarg is a tiny hamlet of two or three steadings and a station-house.

The next day we travelled down the valley of the river Sind. After crossing the stream twice in the neighbourhood of Sonamarg, the road, so long as the valley continues narrow, keeps to the slopes on the right, running along a narrow shelf, more or less high above the river, and at that time sheeted throughout with an extremely treacherous crust of ice. Even in those places in which it was free from snow, it was nevertheless frozen, the ice being formed from water that had trickled down from above. As soon as the valleys widened out again, and became more open, the snow suddenly ceased, and the farther we advanced the better grew the road; in fact, it became at last a first-rate highway, well kept and with a fair amount of traffic on it. We crossed the river six times on well built bridges. The volume continued to increase, until by the time it debouched upon the flat and level valley of Kaschmir the Sind was quite a big river; there, after forming lakes and marshes, it unites with the Jehlam or Jelun. At noon there was a crisp breeze blowing up the valley, but it was followed by a calm. The villages now came closer together; we passed Gagangan, Gunt, Mamer, and a string of others. The scenery was extremely fascinating — in the bottom of the valley deciduous forests, bushes, and meadows, on the lower slopes cultivated fields, and, more especially on the left side of the valley, thick and magnificent forests of conifers. The slopes on the right were for the most part bare, although one would indeed expect that forest would thrive better on the sunny side; but either the soil there is less suitable or the supply of water is not sufficient. After the severe and bitter climate of Tibet, with its low temperatures, the winter in Kaschmir was to me like the mildest of summers. Our last day's ride took us from Kangan *via* Ganderbal to Srinagar; thence I travelled three days down the valley of the Jehlam, and, crossing the pass of Murri, so reached Rawal-pindi.

FROM LADAK TO EAST TURKESTAN.

CHAPTER XXIV.

FROM LEH TO THE KARA-KORUM.

It only remains for me to describe briefly the last portion of these three years of travel, namely the journey from Leh over the pass of Kara-korum to Karghalik. This route has, as is well known, been traversed by numbers of Europeans, and what I have to say about it cannot lay any claim to novelty. But the plan of this work requires that I should describe the western part of Tibet, where the highland is narrowest; for in vols. III and IV I have dealt with the interior of high Tibet. For my own part I was anxious to make some acquaintance with western Tibet after having visited so many other parts of that immense highland region. I was desirous to compare the orographical moulding in the west with the arrangement and general morphology of the northern, eastern, and central parts of the region.

Fig. 304. LEH.

I returned to Leh on the 25th March and left it again on the 5th April, taking with me a caravan of yaks and horses, those of my own men who still remained in my service and a number of Ladakis, who knew the road across the Kara-korum. These men were however to return as soon as we came into touch with Mussulmans who could furnish us with a fresh relay of caravan animals. There is a regular, though small, traffic between Leh and Jarkent, and several of the inhabitants of the little Ladak town have visited the East Turkestan city. At first we retraced our own footsteps across the Tschang-la to Drugub; but I myself took a different route at starting, and went past Hemi, being desirous to visit that celebrated monastery.

The first day therefore I journeyed to Tschuschot (Shushot). In the beginning I followed the road which I have already described, past the long stone kists down to the bank of the Indus, and at Tschoglangtse-tsangpa crossed over the river by two

bridges, for it is there divided into two branches. The volume appeared to be about the same as it was in the end of December, although spring had already set in; at the same time it will certainly have decreased slowly from the end of December to, let us say, the beginning or middle of March, but after that will have increased, and every day it would go on steadily increasing until the summer floods came. The road runs a little distance from the left bank of the Indus, though often it approaches quite close to it. Tschuschot is a straggling village of immense length, and consists of scattered steadings and clay-built houses, with cultivated fields, in which the people were then busy ploughing, the fields being covered with a perfect network of canals. Opposite to us, on the right bank of the Indus, was the monastery of Tikse, perched high on its crags.

Fig. 305. THE BAZAAR OF LEH.

On the 6th April we travelled up beside the Indus between the farms and fields. As a rule the river was not visible; all we could see was its right-hand terraced escarpment. In a cleft of the rocks on the right lay the village of Maschu (Masho), with a *gompa* or monastery. Pretty close to our route ran a distinctly defined terrace, evidently marking a former position of the river, and on the left we passed two small buttes, on one of which stands the monastery temple called Stakna, picturesquely situated like a fort in the middle of the valley. After that the valley grows narrower for a considerable distance; and while we travelled close to the mountains on its right-hand side, the flanks of which were seamed with ravines and transverse glens, the river was visible a long distance ahead of us. Then the farms and the fields ceased, and the surface, consisting of firmly consolidated gravel and sand, was frequently crossed by shallow, though dry, gullies. We left the river at the solitary farm of Tschanga (Changa), and struck off south and south-west up the gravelly scree at the foot of the mountains, and shortly afterwards entered the glen of Hemi. In the entrance to the glen stand several picturesque and tastefully

ornamented *tschortens*, and we also passed several rounded or elongated stone kists with *mane* slabs. The entrance to the glen forms a narrow gateway, and after we got in amongst the mountains we travelled almost due west. Twice we crossed over the rather deeply incised watercourse, the second time on a bridge. At that spot there had been a running brook, though it was then for the most part filled with ice. In the narrow, picturesque glen poplars are fairly numerous. Again we passed a stone kist, for which there was barely room in the bottom of the glen. Above it rose wild and rugged cliffs, and at the head of the glen snow-clad mountains were visible. Before us, at the foot of a precipitous cliff, stood the monastery of Hemi, a slightly packed complex of houses, clinging to the steep face of the rock one above the other like swallows' nests, all of them cubical or oblong-shaped; they looked as if they stood in imminent peril of being crushed by a fall of rock from above. However there is one predominant façade, and with it the fronts of the other houses are all built parallel. As I have given a brief description of Hemi in my popular book, I need not delay longer over it here.

Fig. 306. DANCING GIRLS OF LADAK.

The next day the sky was heavy with clouds, and at 3 p.m. it snowed. We again went down to the Indus, which we crossed on a swinging bridge. Even in the short interval of one day the volume appeared to have increased somewhat, and the stream was muddier, and was rushing tumultuously down between its vertical escarpments of gravel-and-shingle. Shortly afterwards we again struck the road that we had travelled on in December, the road that leads up through the side glen to the pass of Tschang-la. The volume of the brook in this side-glen was considerably smaller than when we saw it before; but probably the greater

Fig. 307. HEMI-GOMPA AS SEEN FROM ABOVE.

Fig. 308. TSCHORTENS AT THE ENTRANCE OF THE VALLEY OF HEMI.

part of it had been drawn off for the irrigation of the fields. At dusk it again began to snow, and the snow fell so thick and fast that we were unable to see anything whatever of the country. Just above the bold bluff that is crowned by the monastery of Dschimre we halted. The pass was said to be practicable, though far more difficult than in December, owing to the quantities of snow which since then

had gathered on the mountains. In order to make a path for the caravan we hired a couple of hundred yaks, which we drove up over the pass, to trample down the snow.

On the 8th April I travelled only the short distance to Tagar. All night it had hailed and snowed, and we suspected that the amount accumulated on the

Fig. 309. THE PRIOR AND THREE OTHER LAMAS OF HEMI.

Fig. 310. TEMPEL IN EASTERN LADAK.

pass would be still further increased. Moreover, the acclivity leading up to it looked threatening and inhospitable, its higher parts being wreathed in thick, snow-laden clouds, which every now and again swept down into the pass, under the impulse of fierce intermittent blasts like those of the Sodschi-la. Only a few weeks before I

had left the hot tropical plains of India, and within another few weeks I should be in the warm and sultry clime of East Turkestan; and between the two intervened the narrowest part of the Tibetan highlands, with its still arctic climate.

Towards evening we sent the two hundred yaks with their eighty drivers up towards the pass to trample down the path, which we intended to use as early as possible the following morning.

Fig. 311. A HOUSE AT DRUGUB.

On the 9th April I crossed over the Tschang-la for the second time. In the evening it had again snowed smartly, but in the morning the sky was perfectly clear, except that a few vaporous clouds like mist formed a fantastic and ragged corona round the rising sun. All the way to Singrul we followed the path on the right side of the glen, that on the left, which we had used in December, being impassable owing to the snow. As the latter side was in the shade, the snow not only accumulated there in greater quantity, but it also remained a longer time proof against thawing. The road on the right also partook less of a break-neck character than that on the left, this being in no slight degree the effect of the snow in levelling up inequalities, and by its uniform softness and whiteness masking the harsher features of the vertical relief. The day was all that could be desired for a journey across this lofty pass: not a breath of air moved, not a speck of cloud to be seen in the sky. For a couple of hours in the morning however delicate, buoyant spicules of ice were floating about in the atmosphere, though without impairing the effects of the sun's power. Very soon after the sun rose, we felt it warm, and it grew increasingly warmer as the day wore on and we ascended, until at noon the heat was more intense than I ever remember it to have been; indeed during the greater part of the day it might quite correctly have been described as painful and oppressive. We had to throw off our overcoats, the sun shone fiercely in our faces, and we longed, but longed in vain, for a refreshing breeze or a cloud to moderate the

burning intensity of its rays. Strangely enough, it was also hot in the shade. But despite the discomfort of the heat, the effect of the excessive insolation, which made the skin peel off our faces in strips, we had nothing really to complain of. To have crossed the pass in a snowstorm would have been dangerous; in any case it would not only have been difficult for the yaks to have found their way through the snow, but the path they trod would soon have been snowed up again.

Fig. 312. A LADAKI.

When we started the snow was hardly a foot deep; but very soon it was twice that depth; above Singrul it was especially thick. It brought with it however one advantage, in that it filled up all the hollows and interstices between the stones and fragments of rock, and to that extent levelled the track; though when you ride a yak, as I did then, the inequalities of the surface occasion you no inconvenience, for yaks can pick their way almost anywhere with extraordinary sureness of foot. As in the Sodschi-la, the snow lay thicker also on the east side of this pass. It was in fact a meter or more deep, and had it not been for the track trampled by the yaks, it would have been quite impossible to cross the pass in one day. Meanwhile we were restricted to the path thus made through the snow by our »yak plough», and every time it became necessary to adjust a load on the back of any of the animals the entire string of horses and yaks that followed after had to stand still and wait. In this way we kept perpetually stopping, and it was not

until we had got over the pass, where we made the usual pause for taking observations, that, in the neighbourhood of the frozen and snow-covered spring of Soltak, we overtook the long black line of the »yak plough», which was in places almost hidden in the deep furrow it had itself made through the snow. The caravan had been busy all night forcing a path through the snow-drifts, which in some places, more especially the hollows, lay to a depth of two meters. After an eleven hours' march we reached at dusk the stone hut of Dag-nagbo, the coolness of the evening being very noticeable after such a warm and strenuous day. We had only one solitary case of snow-blindness, the sufferer being one of the Burjat Cossacks; but after a few days he was better.

313. A TSCHORTEN AT DRUGUB.

On the 10th April we covered the last stage of the common road that we had travelled over in December, namely to Drugub. Notwithstanding the great quantity of snow on the Tschang-la, the last piece of the road had none at all. Even at Dag-nagbo the snow was thin and sparse. The snowfall during the night had indeed made the ground white, but this had rapidly thawed again. Up towards the pass the sky now looked threatening and the summits of the mountains were wreathed in heavy snow-clouds. Nevertheless the caravan of yaks returned home, starting as early as possible before the track which they had made should get snowed up again. At Drugub we spent the night in the same quarters as before, and made the beginning of our preparations for the climb over the Kara-korum. We took with us both yaks and horses, as well as a troop of trusty Ladakis. None of them had ever been over the Kara-korum in winter, so that they were uncertain as to which route ought to be chosen. The shorter was said to be that past the glacier-arms of the pass, though it is often blocked with ice, so that under the most favourable circumstances only a narrow passage is left open between the front of

the glacier-arm and an opposing precipitous cliff. If this passage were stopped up, we should be obliged to make a three days' detour. When we reached Schejok men would have to be sent on in advance to find out which would be the better route to take. The terms that our Ladakis demanded were one rupee per day for each horse and 6 annas for each yak. During the summer these prices are considerably lower.

Fig. 314. LOOKING UP THE TANKSI VALLEY FROM DRUGUB.

April 11th. The route from Drugub to Schejok leads through the lower part of the glen in which Drugub and Tanksi are situated. On the English map the name Durgul is evidently the same as Drugub, although pronounced differently by differents informants. It is a wild and picturesque road: the river has energetically eaten its way down vertically or very steeply through the granite, making a deep narrow, winding gorge, fenced in by bare, rugged cliffs, bizarre yet impressive in character. The bottom of the glen is choked with gravel and stones of all sizes, which materially impeded our advance. The only vegetation was some solitary, ragged bushes, and these were few and far between. There was no grazing, for there simply is no room for it, the glen nowhere widening out. Throughout the glen there is nothing but stone, stone, flung about in picturesque confusion, just as the most capricious fancy would seem to have suggested. Some idea of its curious and inhospitable nature may be obtained from the accompanying photographs (see figs. 314—317, 320).

At first the glen forms a big **S**-shaped bend, in which the road keeps exclusively to the left bank of the stream; but after that we crossed the brook six times. This was rather trying for our large company of men on foot; when the water pressed upon them, they grew unsteady and began to slip; but they are accustomed to balancing themselves on the rounded stones in the beds of the streams. All the way down this bed is full of water-worn, rounded stones. The places at which the road crosses over the stream are where the latter presses close in to

the base of a perpendicular cliff; but some distance lower down the river glides diagonally across to the opposite side, to wash the foot of another cliff, and then we were forced to ford it again. For almost the whole of the way the water

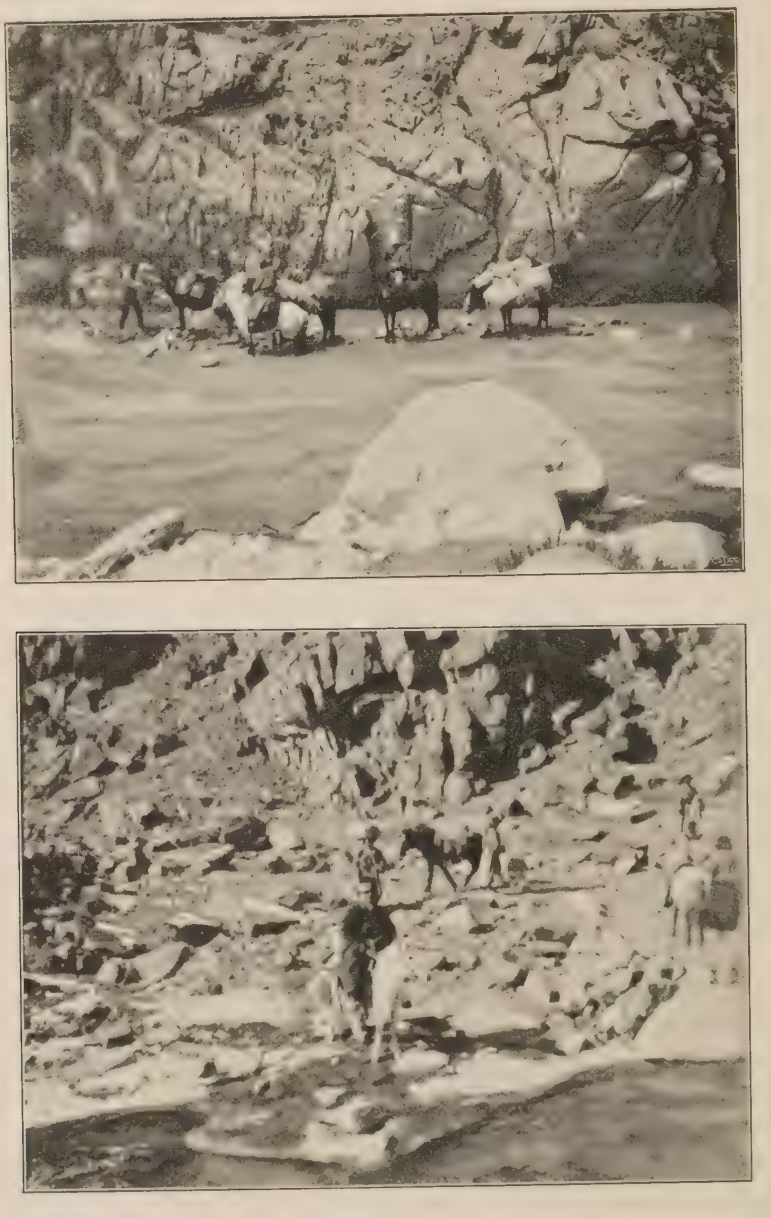


Fig. 315. THE RIVER OF DRUGUB.

foamed and boiled in little restless, broken cascades amongst the stones; it was very seldom that it flowed along quietly for a short distance. The morphology is the same as it is in all transverse glens cleft through granite; the vertical dimensions are more striking than the horizontal. Above our heads towered mighty

VIEW FROM THE VALLEY OF THE DRUGUB RIVER.

Fig. 316. NARROW PASSAGES IN THE VALLEY.

masses of rock, and repeatedly we could not help fancying we were in danger of being crushed under the fall of some overhanging cornice or top-heavy shoulder of the mountain. The view down the glen kept changing every minute, though the glen preserved throughout its character of a gorge or defile. All the same the scenery was not monotonous; it afforded me a true delight to study the singular shapes which the different varieties of the capriciously bedded granite has assumed. Sometimes the rock was striped, sometimes coarse-grained, sometimes grey, sometimes brownish-red. In various places the natives have built bridge-like walls of

stones and slabs along the faces of the precipices, and upon them the road is carried. This is to avoid fording the stream unnecessarily, a task that grew every day more difficult. During the high-water period it is probably quite impossible to cross

Fig. 317. A SHORT HALT.

the stream; it will then be too deep and too furious. Here I found it convenient to ride a yak, for I could safely leave the animal to look after itself, while I devoted all my attention to my map-making, which the winding character of the glen made very exacting.

After we had travelled for a good distance in a direction east and north-east, we again turned towards the north, and having forded the stream yet once again, we struck up the left side of the glen, where the slope was less steep. At length the river appeared like a deep-sunk gorge far down below our feet. The slope on the opposite or right side retains its precipitous character the whole of the way. It rises practically sheer from the bottom of the glen, and wears a dark and forbidding, yet impressive aspect. The road keeps amongst soft material, consisting of stones, gravel, and finer detritus, and is relatively well cared for, although constantly exposed to rock-slides from above. The climb up out of the glen is very appreciable, yet in any case easier than the gorge, which was growing increasingly ruder and more constrained down in the depths below. It was however only the lowest part of a mountain-spur that we had to get over. Its culminating point is crowned by a cairn of stones, an obo decorated with flags. After that we again descended, and the country grew more and more open. Before us lay spread out the big, broad valley of Schejok, with its level gravelly floor,

Fig. 318. A HALL IN THE TEMPLE OF HEMI.

Fig. 319. OUR HOUSE IN SCHEJOK.

across which meanders the Schejok stream. On both sides rise stupendous mountains, half covered with snow; but the bottom of the glen, as well as the lower slopes, were on the contrary quite free from it. Nor was there any ice to be seen, except small patches, and they were soft, in the more sheltered corners of the transverse glens. At length the road trended a little towards the west. Finally, having passed an obo and some small tschortens, we found that we had reached the little village of Schejok, with its simple four-square stone houses. The one that was placed at our disposal possessed a balcony, from which we enjoyed a glorious view of the Schejok valley, a view which we beheld with all the greater interest since we knew that through it ran the road that was to lead us to our greatly longed for goal — Jarkent and East Turkestan.

Fig. 320. ANOTHER NARROW PLACE.

All day the sun had not shown himself once, but a little before sunset he just peeped out for a short while. Towards evening all the mountain-tops were draped with heavy clouds. Next day the clouds were so thick that it was never more than twilight; on the mountains it was snowing fast, so that we were unable to see their tops. It even snowed a little down in the village of Schejok.

Here we took a day's rest and organised the caravan that was to accompany us to the pass of Kara-korum. We required 27 horses. Our baggage was now considerably reduced, for we had no longer any need to carry provender with us for such a long time beforehand. Another three weeks or so would see our journey ended. Our courtyard was therefore the scene of the greatest bustle. The animals' loads were arranged in the most convenient manner, and the horses were shod and groomed after the requisite number had been selected out of 30 from Schejok and 30 from Nubra. In the case of a forced crossing of the pass such as that which

I now contemplated it is a decided advantage to hire caravan animals instead of buying them. True, it comes dearer to hire them; but that is outweighed by the freedom from all responsibility in connection with them. You may safely leave it to the owners' own interest to look after them as conscientiously as possible. It also rests with them to provide forage and to seek for suitable camping-places with grazing. All we had to do was to accompany them; we could safely trust the Ladakis and their local knowledge.

Fig. 321. VIEW UP THE VALLEY OF SCHEJOK FROM THE VILLAGE OF SCHEJOK.

We began our actual march up to the pass of Kara-korum on the 13th April; this was the highest pass of all those that I essayed on the Tibetan highlands. The weather was not particularly inviting for such a venture, for there was reason to believe that with each succeeding day we should advance into severer and colder regions. The sky was heavy with dark and threatening clouds, which trailed along the mountain-sides and drifted down the glen like gigantic pendent tufts of wool. The wind blew and fine snow was falling. With the view of sparing our horses for the exertions that lay in front of them, for the first few days we packed all the baggage upon yaks, which were afterwards to return. Turning our backs, then, upon Schejok, the last little inhabited outpost in the north of Ladak, we plunged in amongst the barren, uninhabited mountains. We travelled at first towards the south-east, crossing over the hills on which Schejok is built. But these we soon left behind us, and then descended into the bottom of the valley, where, to begin whit, we crossed over the stream of Drugub, just above its confluence with the Schejok. Shortly after that we forded the principal stream also and subsequently kept along its right bank. Its volume amounted, I dare say, to about 7 cub. m., as compared with 2 cub.m. in the Drugub, and the water was perfectly clear. The bottom of the valley is littered with grey granite detritus, and is broad and flat, so that the fording of the river was a very easy matter. At the foot of the mountains on the right side of the valley is a strikingly developed terraced escarpment, the work of erosion, with an abrupt and sharply defined edge, while the left side is occupied by the

great offshoot which separates the stream of Drugub from the river of Schejok. Higher up this offshoot is cleft by a deep and energetically carved side-glen, the rocky outlet of which faces Schejok. At last however the valley turned to the east, and then to the north-east, and finally to the north. Just in this part of its course

Fig. 322. CROSSING THE RIVER OF SCHEJOK.

the Schejok river alters its direction in a very remarkable way. The stream comes down from the north, but upon reaching the bend in question it turns sharply towards the north-west. Thus all the way from the Kara-korum pass it succeeds in breaking through the mountain-ranges in those localities in which the

peripheral characteristics are less accentuated; but from Schejok onwards it has to flow, like the Indus (into which it empties), parallel to the chains which run from south-east to north-west. It is in this way that the sharp curve in question has arisen, compelling us to sweep round in a half circle.

At the same time the valley contracts and its bottom becomes filled with detritus. Twice more we had to ford the stream, namely in a little sharp bend, owing to the current there hugging closely the precipice on the right side. In the summer this spot is impassable, as indeed the English map warns us; the bottom of the valley will be then completely filled with water in the narrower parts. We travelled next along the right bank, keeping close to the tumultuous stream. In sheltered places we found balghun bushes growing in great numbers. On the other hand grazing was scarce, though during the latter part of the day kamisch made its appearance, especially in those localities in which the balghun bushes were growing luxuriantly. The mountains on the right descended almost precipitously to the bottom of the valley, and there were signs showing unmistakably that when in flood the river, or at all events a branch of it, reaches close to the base of the cliffs. The bed of the stream is not seldom full of holes, which contain water, then however partly frozen; whereas on the river was there no ice. At these spots the bed consisted of sand, former sand-banks which have become bound together by bushes. The region was absolutely lifeless; we did not perceive a solitary sign of animal existence.

One of these expansions of the valley, with sandy ground, bushes, and kamisch, is known as Tschong-jangal or the Big Vegetative Tract. The Tibetan name of this place is Rangsa-dunmo, and its altitude above sea-level is 3757 m.

April 14th. In the morning the sky was heavy with clouds, and all day the light was diffused, so that all the lights and shades were toned down and the relief features were indistinct. A fresh breeze was blowing from the south, bringing with it fine drifting dust, which covered everything, making both faces and clothes grey. Nevertheless it was a mild and pleasant day; we could not complain of being too cold nor yet of being too warm, as we had recently been when crossing the Tschang-la.

We then travelled due north, the glen running for some distance inconceivably straight, so that it became lost in the blurr that obscured the distant horizon. This made the scenery monotonous, for we missed the variations that are associated with a winding glen and bold rocky buttresses and headlands. All along this stretch the breadth remained fairly constant at 200 to 300 m. Of the total area of the flat and level glen floor only a relatively small portion is occupied by the river; but its dry watercourses and the sharpness of their margins convey some idea of the enormous masses of water which pour down the glen of Schejok in summer on their way to the Indus. In fact, the road by which we were then travelling becomes impassable in the end of April. In Leh and Drugub we had been warned not to put off our start too long, and we were told that, if the weather continued to be warm and bright, the floods would begin to come down about the 20th April, and after that the river would be too swollen to admit of being forded. The volume which we encountered on the 14th April was as much as ever people on foot could get through, though it occasioned no inconvenience to mounted men.

The greater part of the bottom of the glen is choked with granite detritus and stones, all of them round and water-worn, though amongst the coarser gravel there occur long, narrow strips of sand, built up by the current into sand-banks. As far as we possibly could we travelled along these strips of sand, the riding being far easier there; and we were fortunately able to travel in that way for the greater part of the day. Below Tschong-jangal there was a considerably greater amount of detritus.

Even at this point I fancied I could almost detect a decrease in the relative altitude of the mountains, though at the head of every fresh side-glen we caught glimpses of lofty and imposing snowy crests enveloped in clouds, partly shrouding their outlines. Thus on both sides the main ranges were at a considerable distance from us, the ranges that is whose spurs and offshoots abut upon the river, descending to it in a series of greyish brown terraces, platforms, and knobby protuberances. About 50 m. above the bottom of the glen grottoes and hollows have been scooped out in the face of the cliff, obviously the result of fluviatile erosion at some former period.

Fig. 323. MY RIDING-YAK.

The balghun bushes now became far fewer in number, but small thickets of wild briers gradually took their place. During the latter part of the march we observed a few scattered *artschas* or junipers on the slopes and crests of the mountains. Still not a sign of animal life. I dare say that the wild sheep, as well as the antelopes and kulans, avoid this relatively confined locality, prefering the opener mountainous parts where they can keep a good look-out for their enemies.

In the beginning of the march we passed a side-glen coming from the west; this, I was told, is called Darsang-garmo, and has in its upper part grazing-grounds for cattle and sheep in the winter. Farther on is the outlet from the east

CROSSING THE SCHEJOK RIVER

Ljustr. A. B. Lagrelius & Westphal

CROSSING THE DRUGUB RIVER.

TSCHONG-JANGAL.

TSCHONG-JANGAL.

TSCHONG-JANGAL.

THE SCHEJOK VALLEY ABOVE TSCHONG-JANGAL.

of the large side-glen of Jan-tschenmo, up which a road is reported to run to Chotan, uniting higher up with a track that leads from the Panggong-tso to Chotan. On the English map this side-glen is called Chang-chenmo, and its stream is shown as big as that of the Schejok, which is manifestly an exaggeration. At all events the stream that was then flowing down the glen was a mere rivulet, which contributed a fraction of the volume of the principal stream. Just above its outlet we find on the map just mentioned the words »Not passable in summer»; and the glen just there is very narrow and wild.

Fig. 324. ICE AT THE RIVER-SIDE.

Not far from the outlet of the glen of Jan-tschenmo the Schejok river presses close in to the mountains on the right or west, forcing us to cross over it. Above that point the cliffs on the right side of the glen are called Tschagma-tschen, and at their foot is a little vegetation. After fording the river the second time we travelled for a distance on a ridge of sand on the right side of the glen, drift-sand which has accumulated under the lee of a rocky buttress; it does not however form fully developed dunes, probably because it is exposed to gusty winds from various directions. After that the glen winds rather more, but its windings are long and do not waste much time. The bottom of the glen still continued to be broad, and across it the river flings itself from the one side to the other. Finally, just before halting for the night, we crossed twice over the Schejok. We encamped in a locality known as Schubga-go or Kaptar-chane, where there was quite a rich abundance of thriving bush vegetation. The absolute altitude was 3826 m. Sheets of soft ice now began to appear at intervals in the quieter reaches of the river. There too an important side-glen debouches from the west, with great snowy mountains at its head, belonging to the main crest of the range which borders the Schejok region on the west.

April 15th. During this day's march granite was again the predominant formation, though other rocks also occurred, *e. g.*, diorite, white marble, and a light green schist exceedingly fine of grain. The bottom of the glen is completely filled with grey granite detritus and stones, which hurt our animals' feet, thus causing

Fig. 325. VIEWS UP THE SIDE-GLENS.

our advance to be very slow. The yaks in particular began to show signs of fatigue. There were, it is true, tracts of soft sand, but they were far fewer than on the day preceding. The glen then contracts a little; but only a relatively small part of its level gravelly bottom continued to be occupied by the stream. The ascent is very gentle and evenly distributed: as yet we had not encountered any waterfall or even

broken cascade: all such irregularities and thresholds have been long levelled down by the power of erosion. The volume appeared to be unchanged, though as a matter of fact it had experienced a slight augmentation, for it had been joined by various tributaries, though all of them were small. Towards evening there was an evident increase of volume noticeable, a consequence of the perfectly bright sky which prevailed all day and quickened the melting of the snows. It was in fact more like spring than winter, the mountain air was so bright and exhilarating.

Fig. 326. TERRACE OF GRAVEL-AND-SHINGLE.

Although we were approaching one of the loftiest passes on the earth, the amount of snow still continued to be insignificant. It was only on the very highest summits that it lay heaped up to any noteworthy extent, and from them it streamed down the mountain sides in long thin ribbons, though nowhere did these approach the bottom of the glen. With the exception of one or two small patches of ice in the riparian lagoons, the river Schejok was still unfrozen. Thus both the weather and the snow presaged for us a favourable climb over the Kara-korum. And judging from the general character of the snowfall that winter, we had little grounds for fearing that we should be delayed by snowstorms. On our way back from Srinagar to Leh we had on the 11th March found considerable quantities of snow on the Sodschi-la; in fact the gorge was filled with fallen avalanches, and the snow lay thick and plentiful all the way to Dras. On the Tschang-la too we had found it lying a meter deep or more, though a good deal less in quantity than on the Sodschi-la. If now the quantity of snow continued to decrease in this way towards the interior of the continent, we might expect to find less snow on the Kara-korum than we had encountered on the Tschang-la. And in fact we ascertained that such really was the case. Indeed it would appear to be the rule, that every winter the amount of snow decreases towards the more central parts of the highlands, heavy contributions being levied upon the snow-bearing clouds before they reach those parts.

We crossed the river the first time that day just above Kaptar-chane. For crossing we generally selected localities in which the river was flat and broad, 30 to 40 m. across, and not more than half a meter deep, and where the boulders in the bed were not so big as to prove a hindrance. After that we travelled for some distance on the left bank, proceeding north, afterwards north-east, and then we forded the river again. Subsequently the glen became more winding than it had hitherto been and the scenery more diversified and wild. At intervals a side glen debouched, opening out glimpses into the heart of the mountains; on the whole however side-glens are rather few in that part of the country. Along the right side of the glen we observed a mountain path, which, I was told, leads to the open grassy tract of Nja-

Fig. 327. CROSSING THE SCHEJOK RIVER.

jaghmik, where flocks of sheep are wont to be grazed in the winter. We then proceeded along the foot of a vast mass of marble, the rock being snowy white and beautiful to look at, though seamed with cracks. After that our direction was north-west, until we reached a part in which the glen was narrow and inclosed between steep, though not very high cliffs, where we forded the stream three times. From the east enter two large side-glens, and down the lower of these a brook was flowing, though near its outlet it had formed sheets of ice. Every now and again we observed at the foot of the mountains little rivulets, which owed their origin to snow melting in the vicinity, and there too an occasional spring contributed its quota of water. On the left side of the glen there is a saline spring, the incrustations of which have given rise to formations like stalactites. After we forded the stream the third time we set our faces towards the west-north-west; here again there was an accumulation of grey drift-sand. Shortly afterwards we were again forced to cross the river by a projecting headland; then we passed a fresh zone of sand, and a scree of stones, at the foot of which was a rivulet issuing from

IN THE SCHEJOK VALLEY ON THE ROAD TO THE KARA-KORUM PASS

springs and flowing amongst thickets of bushes. On its left side the glen was now overhung by steep, towering walls of rock, with immense screes gushing out of every fissure and every watercourse, and their foot abruptly shorn by the summer floods. We forded the river for the last time near Riung-karu-jogma or Tschahrvagh or Tschahr-bagh, and then encamped at an altitude of 3967 m., at the foot of a gigantic gravel-and-shingle terrace. Above it rise up steep and rugged masses of rock, while narrow, wild-looking side-glens open out towards the west. We had again reached a region in which the scenery is sublime. The vegetation was however scanty, only a few solitary bushes and some kamisch.

April 16th. In order not to weary our animals, and especially the yaks, we made short marches, and generally encamped at the places where the Jarkent caravans are accustomed to stop for the night. During the preceding night violent gusty winds blew in our glen, and every now and again we heard landslips of gravel and stones falling from the terrace at the foot of which we were encamped; in fact our position was far from being safe. Shortly before reaching Tschahrvagh we came across an inhabitant of Schejok, grazing some yaks and sheep; he was the only human being we met with in the course of the whole of our journey through these mountains.

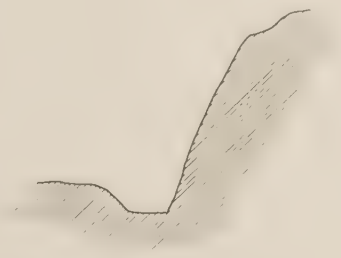


Fig. 328. VERTICAL SECTION OF DEPRESSION AT MANDARLIK.

The volume of the Schejok had now visibly decreased a little. On the whole its glen still preserved the same characteristics as hitherto, and led us north-north-west without windings worthy of mention. At first we advanced for a considerable distance close to the foot of the mountains on the right side of the glen. On this side, as also on the side opposite to it, we now encountered a great number of gigantic screes, the fronts of which often rose fully 100 m. above the glen. Every now and again, in places that are not invaded by the river, we would see köuruk scrub and tamarisks. Upon reaching a minor detached butte, which we passed on our left, we crossed over to the left or east side of the glen by means of a low threshold which reaches across it. The space between the butte and the cliffs on the east is in great part filled with sedimented yellow clay. There a large side-glen, called Galik-tartan, comes down from the east. After twice more fording the river we approached Mandarlik, a peculiar depression scooped out by the stream some time ago at the base of the cliffs on the left side of the glen. There, being well protected, and well watered by a spring, which had formed some small pools, grass, kamisch, and bushes were growing. There were wild-duck. The place, which lies at an absolute altitude of 4145 m., is also called Julghuluk (= Julghunluk) and in Tibetan Bodba.

On the 17th April we again did a very short stage along this remarkable road, which by this was beginning to get monotonous. We were still within the peripheral region and within the confines of the drainage-area of the Indus; as yet there were no indications that we were approaching the vast, relatively flat Tibetan plateau-land. The vertical relief was still the more pronounced; of the horizontal relief we did not see much, for our view was limited on both sides by the lofty walls of rock.

By this the volume of the stream had manifestly decreased. Not only were we approaching higher and barer regions, we had also passed a great many contributories on the way up. Ice-sheets were now more frequently observed in the bed of the river; they were rather large, but all of them soft, white, and brashy. On the other hand, there was no snow in the glen, and even on the mountains it appeared to be less in quantity. We only forded the river once; this receives a considerable increment from a large unnamed glen which debouches from the west. Animal life was still practically absent, save that we saw a few ravens only. But after we got past Jatuk we observed a flock of *arkharis* grazing on the grassy summit of a gravel-and-shingle terrace, but at our approach they hurriedly fled away up the mountains. At Jatuk the altitude was 4212 m. The prevailing rock still continued to be granite; though amongst the detritus at the bottom of the glen I picked up fragments of diabase, porphyry, crystalline schists, and other varieties of rock.

There we dismissed our caravan of hired yaks, for the weary animals only kept us back, and their loads were transferred to the backs of the horses.

Fig. 329. THE POOL OF MANDARLIK.

April 18th. The ascent became rather more noticeable, though without being at all pronounced or in any way troublesome to our horse caravan. Of the river we did not see much, except every now and again a sheet of soft ice. Nor did we cross the stream until we had almost reached our camping-ground for the night. The volume was then only 1 1/2 cub.m., and that consisted chiefly of water which had melted during the day, and had only got down to that point by evening. Yet it was only occasionally that we caught a fugitive glimpse of the river, which for some distance was hidden underneath the detritus that filled the bottom of the glen; it was only in the deeper parts of the channel that it came to light. The

balghun bushes now ceased entirely; we saw the last at Sultan-tschukur, where also a little grass was growing. The rock was still predominantly granite, together with a fine-grained, black rock, either diabase or diorite. The bottom of the glen was littered with loose gravel, which tired us, for it was merely here and there that it was consolidated or replaced by strips of sand. The gullies cut through this material showed by their size and their sharp edges that in summer the volume even thus high up must be very considerable. The glen was on the whole of the same breadth as hitherto, except that at the bends it often widened out considerably. Sultan-tschukur is one of these wider localities. Every now and again a big subsidiary glen would join our glen now from the one side, now from the other. The snow lay thinner and thinner on the mountains, though there was not so much as a trace in the bottom of the glen. The spot where we encamped bears no name. By that we had reached an altitude of 4414 m. The country was perfectly barren; plant-life was confined exclusively to a few scattered teresken plants.

Fig. 330. IN THE DEPRESSION OF MANDARLIK.

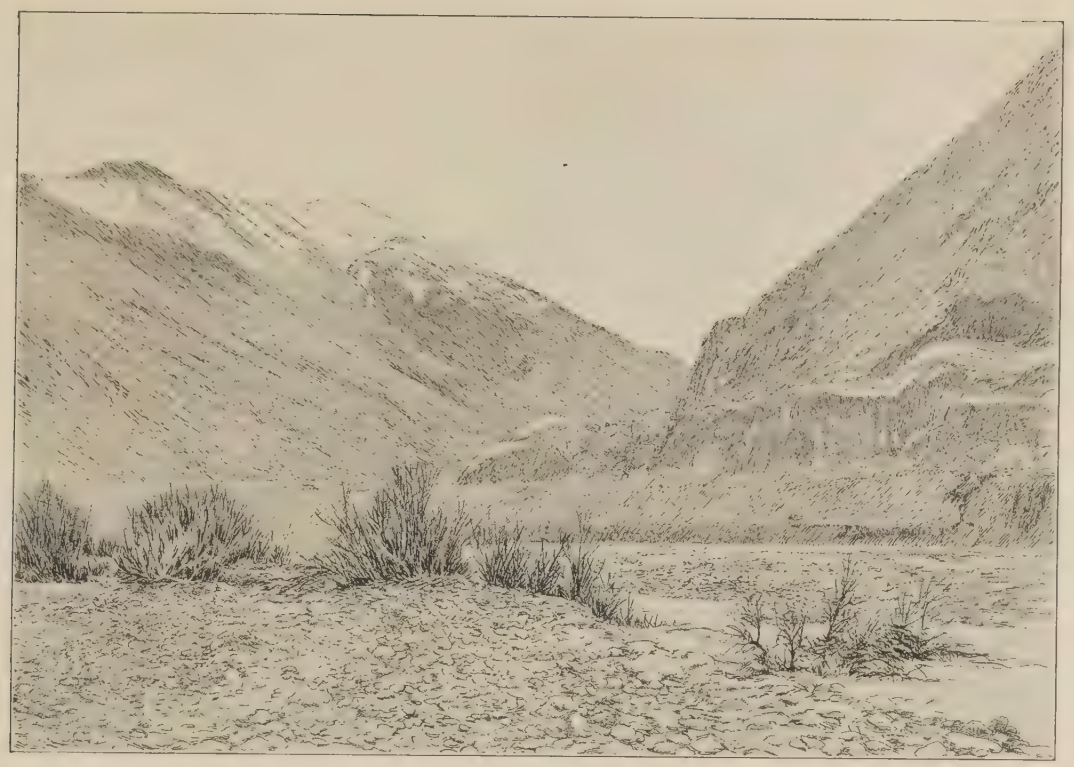
The caravan animals selected for crossing over the Kara-korum are nearly always horses, sometimes mules, but seldom camels, and then of course only such camels as are accustomed to travelling amongst mountains. On the little patch of vegetation that we found at Sultan-tschukur we observed any quantity of camel-dung, apparently a year old. Owing to the loss of baggage-animals which it entails this difficult route has never been favourable for trade between India and East Turkestan, nor does it ever seem likely to come much into vogue for that purpose. Still it is used by merchants from Jarkent; but when they travel with camels they are wont to leave them behind at Sultan-tschukur and carry their wares the rest of the way to Leh on horses. The difficult glen between Schejok and Drugub, as also the pass of Tschang-la, are reputed to be fatal to camels.

During the course of our march on the 19th April the peripheral character of the scenery abated and we ascended noticeably higher towards the immense backbone of the Tibetan highlands. Nevertheless the ascent is extremely gentle, and where the streams flow above-ground they nowhere give rise to rapids. The track is as good as could be expected in a glen filled with detritus. The breadth of the glen still remained the same; side-glens were frequent, and often of considerable size. At first we marched towards the west-south-west, then towards the north-west. We passed ice-sheets pretty often, but running water was scarce. From the neighbourhood of a small detached hill on the left side of the glen we observed the outlet of a vast side-glen bearing S. 53° W. The snow was fast diminishing in

331. IN THE SCHEJOK VALLEY.

amount; even on the tops of the ranges it was scanty. Then the entire bottom of the glen was for a considerable distance completely hidden underneath a continuous field of ice, and along this we rode. It was built up of several different layers and sheets with beds of air between them, so that at every step that our horses took they trampled through. Occasionally however the ice was bright and slippery, and firmer. Down the middle of this ice-field ran a rivulet of unfrozen water, very muddy, and with a volume of about 2 cub.m. in the second. A side-glen which enters from the north-east is said to be called Morgo-rung. In the S. 80° W. we observed a side-glen, which is stated to lead to a smaller pass, and also to Lubra (qy. Nubra). It was quite easy to see, for it follows the slopes on the right of the glen, not the bottom, as the Schejok route does.

In two or three places, where the river (then entirely enveloped by ice-sheets) hugs closely the low offshoots of the rugged diabase or diorite hills on the left, the track runs up amongst them, though it soon returns again to the bottom of the



TSCHONG-JANGAL.

TSCHAHR-BAGH.

THE VALLEY AT TSCHAHR-BAGH.

THE SAME.

CAMPING AT JATUK.

AK-TASCH.

ABOVE JULGHUNLUK.

FROM THE ROAD TO THE KARA-KORUM PASS.

glen. Subsequently the glen trends still further towards the north, and then after once more fording the muddy stream, we came to Ak-tasch (4681 m.), or the White Stone, a name which alludes to a little knoll of marble that there crops up out of the floor of the glen. But apart from this the prevailing rocks all day were fine-grained and black.

The weather was less favourable. In the forenoon the sky was only half clear, but afterwards it became mantled with dark clouds and a strong wind met us in the teeth. In the evening we even had a slight fall of snow; it was fine and whirled about in the wind.

The next day it snowed briskly at Ak-tasch, and we decided to stay there and give the horses an opportunity to nibble the last grass they were likely to get for some days. The snow came down thick, but was of the finest. The wind blew hard, so that the ground in the vicinity of our camp became only partly covered, for the snow was mostly blown away as fast as it fell. Our Ladakis were however of opinion that this snow-fall would not make it impossible to cross over the Kara-korum; at the most it would only render it a little more difficult.

Immediately south-west of our camp we discovered three small glaciers and to the north a fourth. They are streamers from an ice-field which caps the higher parts of the mountains. Very short and very steep, none of them get down to the bottom of the glen. They are fissured at the edges and crossed in front by horizontal bands of dirty ice. At that time however they were enveloped in impenetrable clouds of whirling snow, which swept like drift-sand along the bottom of the glen and the sides of the mountains. After the bright, temperate, and glorious weather which we had experienced in the deep-lying glens we were again plunged into Polar winter.

CHAPTER XXV.

OVER THE KARA-KORUM AND THE SUGET-DAVAN.

On the 21st April we did the interesting stage past the two glacier-arms of Kitschik-kumdan and Tschong-kumdan, both belonging to the vast upheaval of the Kara-korum mountains. The sky was gloriously bright with neither snow nor wind; indeed we actually felt it warm, although not to the same extent as on the Tschang-la. Had the snow whirled as it did the day before, it would have been difficult to make the crossing, besides which we should have lost the spectacle of the wonderful and majestic scenery which is characteristic of that glaciated region.

Fig. 332. VIEW OF THE RIGHT SIDE OF THE KITSCHIK-KUMDAN GLACIER.

At first we proceeded north-north-west on the right bank of the river, amongst a chaos of small hills and heights. The amount of snow in the bottom of the glen increased, but the quantity was not at all serious until we reached the vicinity of Japtschan. We passed close on our left a smaller glacier-arm, or perhaps only the

end of a mantle-fringe; then, after riding for a short distance across moraines of gravel and stones, we reached the edge of the vast glacier-arm of Kitschik-kumdan, with reddish vertical cliffs on our right rising directly from the left bank of the river. We rode gently upwards, having on our left the glassy, glittering, flashing wall of ice. As the ice melted, the water dripped and ran down the face of the glacier and the thousands of tiny rills gathered into a brook. It was no longer difficult to account for the muddiness of the Schejok stream lower down; for the glacier brooks carry with them glacial clay and mud from the bottom moraines. On sunny days the front of this glacier is exposed to the most active ablation, the consequence being that the surface of the ice is most irregular and broken, a confusion of cones and pyramids, with hollows, pits, and crevices between them. The smaller glacier-arms that we passed were relatively pure, although a banded structure is distinctly visible in them; the larger ones contained all the greater amount of impurities and material brought down from the mountains higher up.

Fig. 333. THE NARROW PASSAGE BETWEEN THE KITSCHIK-KUMDAN AND THE MOUNTAIN SIDE.

We were now approaching the locality which we had been warned against in Schejok, as in some years rendering this route impassable. The most advanced frontal section of the Kitschik-kumdan is pushed right across the glen until it encounters the precipitous rocky wall on the opposite or left side. Hence, in order to get past it, you have to climb partly over small steep rocky heights and partly over a chaos of icy fragments, which have toppled down from the front of the glacier and form a veritable ice moraine, the separate pieces of which have become rounded on the outside through partial thawing. In some places they have cemented themselves together into a single compact mass, in which appear dark, gaping holes. At the time of our visit the true glacier front did not actually touch the opposite rocky wall. In consequence of the radiating heat, the melting of the

ice was just at that spot intensified, and in fact there was a narrow passage left by which we were able to advance. It was however excessively contracted, sometimes only 10 m. across; and it was perfectly plain, that it needs but a slight increase in the glacial activity, such, for example, as one or two snowy winters followed by warm, bright weather, and this passage would be completely stopped, and it would be absolutely impossible to advance by that route. But the condition of things changes from year to year, and this is what our Ladakis meant when they said, they could not guarantee that this route would be practicable that year. Had the passage been blocked by the ice, we should have been forced to make the three days' detour to which I have already alluded. However the road was open, though there was only just room for us to get past without lifting the loads off the horses; and strange to say, we succeeded without having a single leg broken in the deep holes that gaped between the ice and the fragments of rock.

Fig. 334. ICE-FORMATION ON THE TOP OF THE KITSCHIK-KUMDAN.

After that we continued north-west up the glen, marching sometimes on the gravelly bottom, sometimes on the sheets of ice, until we came to the still bigger glacier-arms of the Tschong-kumdan. These do not however stop up the road, although there is but little room to spare. Their front, abruptly broken, almost vertical, indeed sometimes overhanging, is in general 20 m. high. The whole of the glen was here sheeted with ice, formed from the thaw-water. This glacier possesses far more moraines than the former, and a large portion of its arms is completely covered under grey detritus, through which the bare rock projects here and there. The ground-moraine appears however to be more developed than the top or side moraines, so far at least as it was possible to judge from the front of the glacier. It is surprising that there exists no trace of any frontal moraine; but not even the smallest ridgelet of gravel is thrust forward by the ice. Yet such must

inevitably be formed at times, though when they are forced by the pressure of the ice behind out into the middle of the rivulet that leaves the glacier, they are soon worn down and carried away by the water. From our route we were not able to see anything of the *firn* region from which the ice-streams of the Kitschik-kumdan and the Tschong-kumdan are fed; we could not even see the tops of the glaciers themselves. Yet judging from the size of the glaciers in front, it is fair to infer that the gathering-grounds of the ice must attain pretty large dimensions.

After leaving the Tschong-kumdan behind us, we proceeded to follow the glen towards the north-north-east. Its bottom was in that part everywhere filled with immense sheets of ice, which were formed in the beginning of winter owing to the water freezing in layers and spreading itself out right across the level expanse of the gravelly glen-floor. Had the ice not been covered with a thin and tough coverlet of snow, it would have been impossible to ride across its bright and slippery surface. In some places it was exposed and appeared to be of a beautiful light, blue-green colour. It was like riding up a long, narrow fjord inclosed between cliffs, the relative altitude of which went on constantly decreasing. After that we did not see the glaciers any more; they exist, at any rate on this route only on the southern face of the vast upswelling, on the upper regions of which the greatest quantity of snow accumulates.

At length the slopes on the right of the glen grew so far flat that we were able to leave the bottom, and ride along the top of the terraced escarpment, although it is gapped by a number of contributory watercourses, sunk in deep ravines, in which the snow lay heaped up so abundantly that our horses were sometimes in danger of being buried in it. In the neighbourhood of Japtschan the snow lay two feet thick even on the smooth ice. None of the ice in this glen remains through the summer; very unlike that in the peculiar glaciated glen which we penetrated into between Camp XL and Camp XLI, where even in summer the ice was 2 m. thick on both sides. As however the ice which accumulates in this upper part of the glen of Schejok during the winter melts again in the summer, it is reasonable to suppose that the thaw-water must give rise to a veritable torrent, and as similar ice formations occur also in several of the subsidiary glens belonging to the Schejok system, it becomes easy to imagine how immense must be the quantities of water which during the warm season of the year will flow down the bed of the united streams. The two glaciers are said to form no dammed up lakes at all.

At Japtschan, the altitude of which is 4886 m., the country assumes quite a different character. By this we had climbed up out of the deep and remarkable glen of Schejok and once more found ourselves on the relatively open uplands. In whichever direction we looked we saw nothing but low, red mountains, half covered with snow. We were again on the »roof of the world», and were approaching the stupendous pass which still separated us from East Turkestan. In the neighbourhood of Japtschan there was reported to be a bite or two of grass, but it was at that time all carefully buried under the snow.

April 22nd. In the morning the weather was good, and although the sky was clouded, it was still and the clouds soon dispersed, and after that the sun shone nearly all day, light flosky clouds just veiling it occasionally. The wind blew how-

ever quite crisply, but came in gusts from every conceivable quarter. Hitherto on our way up to this lofty pass we had been favoured with the very best weather possible; all the same we approached it with a feeling of respect. The actual saddle of Kara-korum is in one regard different from other passes that we had hitherto become acquainted with, in that the acclivity leading up to it stretches over such an extent of country that the rise is quite insignificant. We climbed up to the higher regions step by step, each successive camp all the way from Schejok being one step higher than its predecessor, and we had now reached such an altitude, that there could not be very much of a climb left to the summit of the actual pass. Curiously enough, I felt no inconvenience whatever from the stupendous altitude at which we were moving. I was able to sleep and eat and breathe quite normally. The few days that I spent in Leh had provided a seasonable transition from the lowlands of India to these regions 5000 m. above the level of the sea.

The country that we travelled over was especially favourable, the surface consisting for the most part of hard sand, consolidated dust, and in some places gravel. There was again a smaller quantity of snow and we marched for long distances across bare ground. But the snow was still deep in the gullies, watercourses, and hollows, often a meter deep, and was so hard and strong, that usually it would bear the weight of a man, though not of a horse. We felt it cold in consequence of the wind, and it was not possible to keep ourselves warm by walking, for owing to the rarefaction of the atmosphere we soon suffered from shortness of breath. The Ladakis however seemed not to feel it, for they marched along as easily and as unconcerned as if amongst their native mountains.

During the course of the day it became clear that we were travelling along a frequented road, for it was literally strewn with the dead bodies and skeletons of horses. We had indeed come across some the day before, though in far fewer numbers; perhaps this was because they were in great part buried underneath the snow. Now however they became very numerous, and we were constantly passing skulls that lay and grinned at us from the roadside. Only a few of them still retained their skin or portions of the flesh: there were ravens in the neighbourhood and no doubt the opportunity is one that other creatures of prey do not neglect. There were also skeletal parts of asses and camels, though they were far less common. The great accumulation of bones in this particular locality seems to suggest that the caravan animals when coming from Jarkent generally succumb after they have exhausted their strength in surmounting the passes of Sandschu and Kara-korum. Unless they are exceptionally strong, they do not appear able to get any farther than this region. A small portion of the skeletons belonged, it is true, to animals that came from Leh; but, as we have seen, the track on that side is not especially difficult, even though the Tschang-la is always a hard nut to crack. In any case the most difficult and the most sterile part of the entire journey is that which comes north of the pass, not the least cause of this being the rugged character of the Kwen-lun mountain-system.

We next travelled north-east. After crossing over the ice-sheet of Japtschan, we slowly ascended over undulating ground, amongst low mountains of red, soft disintegrated material and relatively so insignificant in height that they were more

like hills. The country assumed more and more the character of an undulating high plateau, with bigger mountains rising above it like islands here and there, all completely covered with snow. To the north-west appeared a broad passage, with lofty mountains in the background.

On this undulating surface we soon hit upon a shallow watercourse full of ice from a spring close by. This ice we left at Jagbe-pulu, and climbed up to a sort of platform swelling between fairly defined watercourses. There we found the ground excellent; the snow lay only in thin strips. A little bit farther on a broad glen opened out towards the N. 72° E.; through it comes the Dapsang road, which traverses the already mentioned glen of Morgo-rung. This is the road we should have had to follow, had the Kitschik-kumdan prevented us from advancing by the route that we did use. The pass of Dapsang on this route is said to be especially difficult, and the detour altogether very trying to the patience.

Farther to the south-east we perceived a more important mountain-mass called Dorat-bi. After travelling for a short distance east, we again turned north and north-west, making our way up the glen of Balti-pulu, where the Dapsang route unites with ours, after running for a space close beside it. At the apex, between two watercourses, stands a little stone hut. Around it the ground was literally covered with the bones and skulls of dead animals. This glen contained neither water nor ice, and is bordered by gentle slopes and low hills. Of grazing there was not a trace, and as for water, the traveller has to make shift with snow. The ground in this region, which is known as Tschader-jilgha(or Tschajos-jilgha), consists of fine gravel; hard rock is absent on this lofty swelling, just as it so frequently is in the interior of Tibet. The altitude was 5290 m., so that we were not far from the pass.

On 23rd April we at length crossed over the Kara-korum. The day was anything but favourable: a snowstorm was raging and it was twilight. It was now that I first felt any inconvenience from the great altitude, namely a headache and nausea. The caravan started at 7 a.m. and I followed it two hours later. The road proceeded up the glen to the north-west. Again the snow increased in quantity, and in the bottom of the glen it was soon so deep that we were unable to ride through the snow-drifts, but had to keep to the slopes on the left of the glen; this however was irksome enough, because the substratum very often gave way and we were in danger of sliding outwards. Owing to the blinding snow it was difficult to form any idea of the configuration of the country; all we could see was the nearest heights. Our animals were now beginning to feel the ascent; they were breathing heavily, and every score paces or so they stopped to recover breath. The side-gullies, which kept incessantly breaking through the slopes, were especially disagreeable, being filled with snow to the depth of a meter or more, so that we were in imminent danger of having our horses down. The acclivity increased in steepness. I overtook the caravan where the road turns to the right, that is to the north, north-east, and east, close under the pass. I found that they had had all their work cut out to force their way through the increasingly deeper snow. The horses kept falling again and again, and had to be unloaded and helped up, so that our progress was painfully slow. Had it not been for the snow, the pass itself would have been a mere trifle, apart of course from the stupendous altitude. In winter

it is the immense amount of snow besetting the pass which makes it so difficult, whereas in summer it is the quantity of water in each of the main glens on both sides of the pass.

335. CROSSING THE KARA-KORUM PASS.

Even the very last portion of the ascent is gentle. Hence all the way from Schejok we had been climbing up to the pass at a wonderfully easy and uniform rate; it cannot be said that at any one single point we encountered real difficulties owing to the nature of the ground, so that it was not easy to believe that we were approaching one of the highest, if not actually the very highest, pass on the earth

Ljustr. A. B. Lagrelius & Westphal.

VIEWS OF THE KITSCHIK-KUMDAN-GLACIER.

Ljustr. A. B. Lagrelius & Westphal.

VIEWS OF THE KITSCHIK-KUMDAN-GLACIER.

that is used by caravan traffic. Its altitude is 5658 m., or 850 m. higher than the top of Mont Blanc. On the summit two cairns of stones have been built. The declivity on the northern side is rather steeper at first, but it soon grows easier, and finally becomes very flat.

Only a few minutes below the pass we came to the painful spot where Dalgleish was murdered in 1888. The sad event is commemorated by a heap of stones and a marble slab, though the latter has been broken. On one of the fragments I read however the letters -LEISH. One or two of my people told me, that in the winter of the year mentioned the snow lay very deep all round the pass, so that Dalgleish's caravan had to pitch their tents on the snow just under it.*

* In connection with the unhappy fate which befell Dalgleish at the northern foot of the Kara-korum, I will add a few particulars which have come to my knowledge. Dalgleish had made several commercial journeys to Jarkent and other towns in the Tarim basin, and had crossed the Kara-korum mountains at several places. At the same time he drew up maps and made observations of great value, enlarging in no slight degree our knowledge of the interior of Asia. In the year 1885 he participated in Carey's great journey in East Turkestan and drew up a map of their joint itinerary. He had made it his life's object to regain the trade of East Turkestan for England and therefore himself accompanied his caravans to Jarkent. At the same time he learnt that everywhere Russian commodities were sold cheaper than English, because the Russian means of communication are both shorter and more convenient. Owing to his patriotic efforts he had made his name popular both in India and in England, so that, when the news came, that he had been murdered in March 1888 whilst making a fresh journey to Jarkent, it awakened both general sorrow and sympathy.

As soon as the news reached M. Petrovskij, the energetic Russian consul-general at Kaschgar, he at once instituted inquiries. Muhamed Isa, one of Dalgleish's attendants, who was subsequently with Dutreuil de Rhins when he was murdered, upon his arrival in Kaschgar was subjected to a sharp and stern cross-examination. The Sart merchants, Russian subjects staying in Jarkent for business purposes, were called upon to give all the information they could calculated to throw light upon the crime, and, finally, special messengers were despatched to the scene of the occurrence. In this way M. Petrovskij succeeded in clearing the affair up, and he kindly gave me the following information about it, which deserves to be rescued from oblivion.

In March 1888, then, Dalgleish was on his way to the pass of Kara-korum, with a caravan of Indian goods, which he proposed to sell in Jarkent. During the journey he was joined by an Afghan merchant, Dod Muhamed Khan, a man whom Dalgleish knew, and who begged to be allowed to bear him company to Jarkent. Dalgleish acquiesced in the request, and instructed Osman, his caravan-baschi, to appoint the Afghan a place where he could march with the caravan, and a corner in one of their two tents where he could sleep at night. For three or four days they accordingly journeyed on together. After they had pitched their tents between the pass and Barangtsa, Dalgleish went into the men's tent, where Dod Muhamed sat drinking tea. Dalgleish sat down and joined in the conversation. Shortly afterwards Dod Muhamed Khan rose and went out, and then fired a shot through the tent-canvas, which struck Dalgleish in the right shoulder. The Englishman sprang to his feet and ran towards his tent to get his weapons; but was followed by the murderer, who dealt him such severe wounds with his sabre, that poor Dalgleish fell before he was properly able to defend himself. In answer to Petrovskij's question, as to why Osman or any of the other men had not hastened to the assistance of their master, they said that the murderer had one or two friends with him, who like himself were fully armed, whereas the rest of the caravan was unarmed. After the deed was done Dod Muhamed said coolly to Osman, »I have killed that man and will answer for the consequences. You may continue your journey without fear. I shall remain here.» Thereupon the caravan had resumed its march, but two days afterwards it was overtaken by Dod Muhamed, who had seized the money of the murdered man, though he did not meddle with any of his other possessions. These were in part found by the agents whom Petrovskij sent out.

Dod Muhamed afterwards went from Jarkent to Kaschgar, where he stayed five days in the Afghan caravanserai with his fellow-countryman Nigbet Ullah Khan. When he no longer felt safe in the latter city, he fled one dark night to Aksu, being accompanied a part of the way by Dildar Khan, the aksakal of the Afghans. This man, who was still in Kaschgar when I first visited that city in 1890, procured the murderer a false pass, which enabled him to travel to Utsch-turfan and Irkeschtam, and so across the Russian frontier, whence he made his way to Masar-i-Scherif, where the Emir Abdurrahman was at that time residing.

The quantity of snow was still considerable, and, as in the case of the Sodschi-la and the Tschang-la, the greatest amount lay on the inner or Central Asian side of the pass, being there 1 1/2 to 2 m. deep. The road bore to the north and north-west, and it was with extreme slowness that we succeeded in making our way through the snow-drifts. The storm continued with unabated violence. It was clear we should not reach Barangtsa by evening, and so we were forced to encamp amongst the snow-drifts, at an altitude of 5485 m.

On 24th April the weather still continued unfavourable. It had snowed all night, and was snowing still next morning. The snow itself whirled in veritable clouds along the ground, so that our immediate surroundings were for the most part blotted out. It was only occasionally, that we caught faint glimpses of the flanks of the mountains, though we felt somehow that there were lofty mountains on both sides of us. At noon it lifted a little, but soon the storm burst again, the heavy clouds driving before a wearisome wind. This sort of weather is of course characteristic of these lofty uplands, even in the spring. Two hours after we had left camp the snow was still deep; but after that, although the slope is very gentle, it decreased rapidly in quantity. When we reached Barangtsa the ground was half bare, only the gullies and fissures being treacherously filled with snow. On the other side of Barangtsa there was but the very scantiest amount of snow; even in the hollows it was thin. The surface which we then rode upon was of first-rate character, partly fine gravel, partly hard sand and soft dust, so that the caravan was able to make more rapid progress than it had done anywhere since we left Dschimre.

The road follows the glen that runs north-east down to Barangtsa. At this place it was said that we should find a little grazing, although a short distance from the road. There too we hit upon a spring, which had given rise to large ice-sheets. After that the principal glen ran a little way off on our left, while we rode down a side-glen, broad and shallow, the bottom of which contained a good deal of ice on its tiny spring-fed rivulets. Then for a space we again followed the main glen, until we ascended its right terrace of red earth and so approached the spring of Baksum-bulak. The ice-sheets of this we then crossed a couple of times; thereupon we followed a plain, called Tschader-tasch, with one or two little free-standing buttes. Round about these lay innumerable skeletons of horses, together with some of camels. Amongst these it was easy to distinguish several different years. Some of them were

During the time that the murderer was in Kaschgar and Aksu, Petrovskij, through his secret agents, was able to keep him under surveillance and could have seized him at any moment; but without the consent of the English minister in Peking he did not feel warranted in taking such a step. Several months must elapse before he could receive a reply, and when at length the minister's request did arrive for him to seize the prisoner at all costs, it was too late, the Afghan was already safe in his own country. Two years later Dod Muhamed, thinking that the affair was forgotten, returned to Samarcand. There however he was recognised, and on 8th March 1890 he was arrested by the Russian authorities and thrown into prison, where on 30th March he hanged himself with his own girdle. It was said that Dod Muhamed was led to this evil deed through an old grudge which he bore to Dalgleish. A Hindu merchant had once consulted Dalgleish with regard to Dod Muhamed's affairs, whereupon Dalgleish told him, that the Afghan was anything but trustworthy. Upon learning this, the Hindu had refused to let Dod Muhamed have goods upon credit, and when the Afghan asked him for the grounds of his refusal, he told him what Dalgleish had said.

Dalgleish occupies an honoured place in the history of Central Asian discovery, and it is for this reason that I was unwilling to withhold what I have learnt as to his unhappy death.

of so recent a date that the skin still remained blown out over the ribs like inflated goat-skins; others were entirely free from skin; others were bleached by the sun; and yet others soft and rotten from the effects of wind and weather. In this locality we observed the tracks of wolves, and there were also ravens. In a little niche of the rocks at Dschadung or Dschaghdung we found a small stone hut. At the same place there was a sprinkling of grass; but the spot afforded no running water, only ice and snow. Its altitude above sea-level was 5023 m. The country thereabouts is very open, forming a flat plateau between the Kara-korum and the Kwen-lun range, in which the pass of Suget-davan is situated. The latter range was already visible in the distance. During the second portion of the day's march the country was as a fact so level, that it was scarcely possible to determine in which direction the surface sloped.

On the 25th April the snow-storm and gale still continued; clearly the climate here was continental, quite different from what it was on the south side of the Kara-korum pass. Of our surroundings however we were unable to see much, for at the distance of a couple of hundred meters everything was swallowed up in the blinding snow; it was only occasionally that we caught a glimpse of a hill or scarped erosion terrace. Apart from that there was nothing to be seen except the cold grey, inhospitable haze which surrounded us on every side. Of the sun there was not a sign, and mile after mile we tramped doggedly across that uniform, desolate, barren plateau, the surface of which is strewn with gravel or sand, and littered with countless bones and skulls of horses, so much so that they almost seem to form a characteristic feature of the landscape.

In the morning I sent on one of my own men and one of the Ladakis to Schahidullah, to warn the people of our approach and to beg the bek of the district to have in readiness for us 25 horses, yaks, or camels to convoy us down into East Turkestan. Our hired Ladaki horses had hitherto done us excellent service, but a few of them were now beginning to show signs of weariness.

We proceeded farther towards the north-north-east down the *saj*, or relatively broad and shallow glen, the fall being however imperceptible to the unaided eye. Had we not known that that particular watercourse drains into the Raskan-darja, we should hardly have been able to determine in which direction the ground sloped. The Kara-korum pass is as a water-divide of a very different rank from the lofty passes which we crossed over farther east in the interior of Tibet. The springs that feed the rivers which run down to the eastern part of East Turkestan are situated relatively close to the northern margin of the highlands, and on the south side of their water-dividing ranges spread the vast internal-drainage expanses of central Tibet, broken up into a great number of self-contained basins. It is not until you get a long way farther south, that you reach the regions which drain to the Indian Ocean, namely those in which rise the tributaries of the Brahmaputra or Tsangpo and those of the Indo-Chinese rivers in the east. The regions of internal drainage narrow so rapidly towards the west that at the Kara-korum pass they have entirely tapered away. From the southern side of that pass the thaw-water runs down to the sea; on the northern side it makes its way into East Turkestan, so that there is there no self-contained drainage-area, however narrow. And just as the river

Schejok on the south burrows deeper and deeper in amongst the mountains of the pheripheral region so also does the north-going river, the Raskan-darja or upper Jarkent, which, there can be no doubt, has carved for itself quite as wild and fantastic a passage through the border-ranges in the absolutely inaccessible glens by which it breaks through them. Indeed in this regard the characteristics of the peripheral region are even more emphatically reproduced. Down its glen there exists no road to Jarkent; the traveller has therefore to quit the glens and make his way down to the lowlands over the border-chains, crossing them by lofty passes.

Meanwhile we followed the *thalweg*, near which a small rocky pinnacle, called Näsir-tasch, rises like a pyramid from the level ground. The road is everywhere distinct, except where it runs along the bottom of the *thalweg*, and there it is washed away every summer. What helps especially to mark the road is the skeletons; in fact, it could hardly be staked out in a more conspicuous manner. For a couple of hours we rode down this watercourse, which is about 200 m. broad and fenced in by scarped erosion terraces, 10 to 15 m. high. These form the limit of our field of vision; the whirling snow prevented us from seeing what lay beyond them.

We now approached an important point. From the east enter a couple of tributaries, and the united stream then runs north-west towards the region of Aktasch. Here we were then at the common confluence of three of the head-feeders of the Raskan-darja. There were large sheets of ice in the broad flat bed below the confluence, and also open water from springs. In the middle bed there was even a tiny rivulet. Its glen debouches from the right upon the before-mentioned route from Jan-tschenmo.

Upon reaching that point, the lowest that we touched (alt. 4847 m.) during the course of the day, we turned away from the united glen and rode up the side-glen on the right. That led us to the north-east and north, the ascent being noticeable without being in any way a strain. In the bottom of the glen there was neither water nor ice. For hours we kept along its left-hand terrace; the right terrace we could not see for the blinding snow. Hitherto the ground had been practically bare, except for an occasional strip of snow; but in the afternoon it began to snow more violently than it had done for a long time past, and very soon the entire country was again white, except for a few black dots showing here and there. On the recent horse skeletons the snow settled as softly and as lightly as cotton-wool. We were then travelling along the right erosion terrace of the glen called Tschibra, which leads up to the Suget-davan. For hours we rode through the thickly falling snow, unable to distinguish any other features of the landscape except the terrace we were moving on, the only thing which told us we were on the right road. High up the snow was a foot deep, and we advanced more and more slowly; fortunately there was no wind. When it grew dusk, we halted at the foot of the erosion terrace, with nothing around us except snow, snow, snow, not a blade of grass, no fuel, no water! It snowed throughout the evening, coming down thick and fast, until even the few black specks disappeared. The unbroken coverlet of snow shrouded like a pall of purest white the desolate, silent, uninhabitable country, hiding from sight its harrowing evidences of suffering and misery. The altitude of our camp in the Tschibra valley was 5130 m.

The 26th April was one of the hardest days that I have experienced in Asia. Our immediate object was to surmount the pass of Suget, a much more difficult one than that of Kara-korum. Under the existing conditions, I would rather cross over the Kara-korum five times than climb over the Suget once; and yet when we crossed over the former it was in a blinding snowstorm, while when we faced the latter the sun was shining brilliantly, though at the same time there was a stinging wind from the north, which blew directly in our faces, chilling us to the bone, so that we sat in our saddles like apathetic and insensitive automata. Owing to the stupendous altitude it was not possible to warm ourselves by getting off and walking occasionally; at least it was not possible for me, for no sooner did I attempt to walk, even down a slope, than I experienced the greatest difficulty in drawing my breath. I was lost in admiration of the Ladakis, who trudged along on foot all the way, lively and with snatches of song on their lips; but then they have of course grown up amongst mountains, and both their lungs and their chest are adapted to breathe the rarefied mountain air. They also appear to be insensitive to the cold, for they used to sleep out of doors without any tent, merely rolled up in their sheepskins; you would expect them to freeze to death, at any rate to get their limbs frost-bitten. In regard to hardships of this kind different people naturally possess different degrees of endurance. My Siberian Cossacks, for instance, never felt any inconvenience from the cold, and once they were accustomed to it they never after 1900 experienced any difficulties from the rarefaction of the atmosphere. But when I took one of them with me down into India, he was nearly killed by fever in the hot climate of the lowlands. From about the time we left the pass of Kara-korum I myself suffered more from the rarefaction of the atmosphere than I had ever done before; probably this was because I had shortly before spent some time down in India, only very little above the sea-level. Those of my men and the other Cossacks who had passed the winter in Leh were less sensitive on this score than I was. When I was at Kaschgar in the winter of 1890—91 I saw a Hindu, who had crossed over the Kara-korum in November, and the journey had cost him both his feet; for they had got frost-bitten and had to be amputated. His weak physique, accustomed to a tropical climate, had been unable to withstand the severe cold.

As a consequence of the vivid sunshine which we then had, we also suffered a good deal from the glare of the snows. The facets of the tiny snow crystals sparkled like diamonds in the intensely bright sunshine, and even though I put on two pairs of tinted glasses, I nevertheless felt my eyes painful. Although not very sensitive in this respect, even our Ladakis had to protect their eyes. A few of them wore darkened spectacles; others put on a kind of woven horsehair eye-covering; while yet others contented themselves with sticking a bunch of horsehair in under their hats, thus making a shade or protection for the eyes. Most of them however were satisfied with simply pulling their caps as far down over their eyes as possible. In a similar case the Kara-kirgis (Kirghiz) of the Pamir are wont to modify the sun-glare by wearing spectacles made of a thin plate of wood with a horizontal chink cut in the middle. Another, and original, device which I also saw employed on the Pamir was to blacken the nose and the skin round about the eyes with soot or charcoal, which to some extent tempers the rays that are reflected from the face it-

self. Remarkably enough our horses stood the journey well, for although they had had no grass worth speaking about for six days, they all got over the pass satisfactorily. Those of our Ladakis who had travelled that route before were unanimous in declaring that it was an especially favourable year, and that the quantity of snow was very much less than usual at that season. For my own part, I conceived a profound respect for the Kara-korum pass, and see only too well that it is exceedingly unsuitable as a regular means of communication between the interior of Asia and India; in fact, it is surprising that it is ever used at all, for the losses amongst the caravan animals must seriously enhance the price of the wares they carry. As compared with the passes on this route, those on the different routes between Russian territory and East Turkestan are mere child's play. Indeed, not even in Tibet have I anywhere met with such a difficult country as this is. One or two months later this road would of course be very much easier — that is, in so far as the quantity of the snow was concerned; but on the other hand you then have to reckon with the flooded streams that fill the deep glens of the peripheral region.

Fig. 336. IN THE SNOW OF SUGET-DAVAN.

The snow came down all night and next morning lay a foot deep in the Tschibra glen, and the higher we ascended the deeper it grew. I started an hour after the caravan, but soon caught it up, for it had got stuck fast in the snow-drifts. For the most part the snow in these drifts appeared to be newly fallen; it was light and but little consolidated and seemed hardly to lie upon any substratum of older, tenacious, compact snow. It is of course very appreciably easier to plough your way through soft, newly fallen snow than through old, hard snow; but all the same it is tiring, and entails great waste of time, especially at such an altitude. We were anxious to get over the new pass. Hour after hour we toiled up through the snow-

drifts; but no pass hove in sight, although our Ladakis declared that we were close to it.

First we bore north until we reached Tschibra proper, a stone hut at the outlet of a side-glen coming from the north-east. After that we proceeded west-north-west and north-west, still continuing to ascend by the same eroded glen; but at length the acclivity decreased to such an extent that the surface appeared to be almost perfectly level, apart, that is, from the hills which rise on both sides of the broad *thalweg*. Finally we left the main glen behind us on the south. In a side-glen close by the snow lay 3 m. deep, and it took us a good half-hour to get the caravan over the awkward place, for we literally had to dig out a path through the

Fig. 337. THE WAY UP TO THE SUGET-DAVAN.

accumulation of snow which the wind had driven together. The strength of both men and animals was tried to the uttermost; we advanced only a score of paces at a time and then we had to »take soundings» again. Some of the men went on first, then followed one or two of the horses, and then the rest of the caravan. In some places the horses failed to find bottom, that is to say, they did not touch the surface of the ground, and consequently kept falling incessantly, while we were as often flung out of the saddle, though for a good thing our fall was soft! Time and time again we had to readjust the burdens after they had slipped off.

The last portion of the ascent grew a trifle, but only a trifle, steeper. The summit of the pass, the goal of so many weary travellers, is crowned by a cairn of stones. Its absolute altitude is 5434 m., or only 224 m. lower than the pass of Kara-korum. The amount of snow on the Suget pass was very appreciably greater than on the Kara-korum, although the former lies nearer to the heart of Asia with its arid climate. It should however be observed, that most of the snow

was fresh-fallen; evidently it had come down during the last two days and nights, and the probability is that an even greater quantity had fallen on the Kara-korum, so that, had we reached it a couple of days later, it would have been impossible to force our way over it. At first the snow lay much deeper on the northern versant of the Suget-davan than on its southern side, precisely the same experience that we had on every pass all the way from the Sodschi-la. But unlike what we found on the Kara-korum, the quantity here decreased pretty rapidly, so that by the time we reached the bottom of the declivity and the well-defined glen which runs thence towards the north, the snow no longer occasioned us any inconvenience. The northern declivity is fairly steep. The horses scrambled down from the pass at haphazard, plunging headlong through the snow-drifts; there was nothing whatever to indicate a path.

Fig. 338. DISTRIBUTION OF SNOW ON THE SUGET-DAVAN.

The upper part of the glen, by which we now descended at an accelerated pace, is about 50 m. broad, and is bordered by pretty distinctly defined erosion terraces. It runs north-west, without any noteworthy windings. Its bottom is filled with moderately coarse gravel, and at that time possessed neither water nor ice. On our right we passed the side-glen of Kutas-jilgha, coming from the north-east, and just past its outlet we pitched our camp in the bottom of the main glen, where there was any quantity of japkak scrub, so that at least we were able to make fires to warm ourselves at. Yet there was no other fodder for our horses except this hard woody scrub.

CHAL-TÜSCHKÜN; ON THE SPUR TO THE LEFT IS A MASAR.

CHAL-TÜSCHKÜN.

CHAPTER XXVI.

FROM THE SUGET-DAVAN TO JARKENT.

On the 27th April we again had brilliant sunshine, and it was with a feeling of pleasurable relief that we approached a less rarefied atmosphere and a more hospitable climate, more plentiful vegetation, and inhabited districts. Although rather narrow, our glen grew increasingly better defined: on the left it has vertical or precipitous walls of rock, while towards the opposite side it is occupied with gravel-and-shingle detritus and fragments of granite, with here and there a terrace-like platform. The snow, which had vanished so rapidly below the pass, now increased again in quantity; but this was for the most part accounted for by the glens inclining towards the north-east and east-north-east and so lying deeper in the shade. From the left debouches the side-glen of Suget-rongo, and there we found a spring. Shortly after that a rivulet made its appearance, and the bottom of the glen was for a considerable distance filled with continuous sheets of ice. The snow lay decimeters deep on the ice, though the gravelly portions of the glen-bottom were quite free from it. Next came, on the right, the side-glen of Suget-aghsi, and in an elbow below it quite dense thickets of balghun bushes were growing amongst the ice-sheets, and under the latter we heard the water rippling. Nevertheless the track is rough in consequence of the masses of stones of all sizes that are intermingled with the gravel. Grass now began to make its appearance.

At length the glen widened out and we approached Suget-karaul, a small square fortified wall, of which a couple of Kirgis were in charge. The fort stands on tolerably level ground between the Suget brook, which hugs closely the cliffs on its left all the way, and the large Kara-kasch-darja, which issues just there. In the evening the Kirgis bek of the district arrived to inquire what number of baggage animals we needed, as also to gather materials for a report about us to the amban of Jarkent. He was amazed at our having been able to cross over the pass at that season, and told me, he did not remember that it had ever been done before. In his opinion the pass would then be for some time closed, until the sun was ready to begin its spring work in earnest. At the next camp we left our Ladakis; but they would have to wait two or three weeks until the climb over the pass became easier. Under ordinary circumstances most snow is said to fall in the beginning of

the year, but in that particular year it had begun only one month before the time of our arrival. It was expected therefore that the stream would carry a bigger flood than usual.

April 28th. After leaving the big gravel-and-shingle terraces at the foot of Suget we gradually approached the Kara-kasch-darja and then travelled down its left bank. The bottom of the glen still continued to be filled with detritus and stones of all sizes; but the köuruk bushes became increasingly numerous and were growing on small mounds. On our left we passed a side-glen, up which was a track leading to the summer grazing-grounds, and then, evidently, farther on over some pass to Kok-jar. At first the stream flowed north-east, and then north. Its glen, which

Fig. 339. THE BEK AND OTHER KIRGIS AT CHAL-TÜSCHKÜN.

forms an expansion at Suget, contracts again after that, and at about 50 m. above its floor old erosion terraces were visible. Here we met with partridges and wild-duck; but nobler game there was none, owing, I was told, to the poverty of the grazing. We crossed the river twice; at one point, where the stream brushes the foot of the mountains on the left side of the glen, there were still fairly thick ice-sheets. At Chal-tüschkün a side-glen enters from the S. 80° W.; in its outlet stands a small stone hut and on a little pinnacle is a masar. Here we encamped for the night at an absolute altitude of 3618 m. A little higher up this glen was the encampment of the bek, where he had around him his camels and horses, and sheep and goats. He said he had lived for sixty years in that locality and latterly had served as karaultschi. Out of the glen of Chal-tüschkün issues a brook, which during the night had grown to three times its former size; by that time the volume of the main river had likewise augmented considerably. During the day it had been only partly fine and twice there fell a sprinkling of snow. In the summer the Kara-kasch-darja is said to be so big that there are only two places at which it can be

forded, and even then horses have almost to swim. There is no boat to be had; probably the current is too swift for boats. On the lower Schejok we had passed the remains of a boat, showing that the people there had attempted to keep open the Kara-korum route in summer by means of a ferry.

In this region, which is barren and uninteresting, it is said to rain seldom in summer; nevertheless it is important as being the starting-point for one of the routes to India. Another road also starts from the same place for the pass of Kilian, though it was then reported to be still blocked with snow.

Some thirty to forty Kirgis had been requisitioned from the camping-grounds in the neighbouring valleys, and each man came bringing with him one or two camels or horses, and the mustering of this little force took place in a commendably short space of time, especially as some of the men were said to live at a distance of two or even three days' journey.

On the 29th April the weather was splendid, the sky being bright, and again we began to feel it warm. There was no snow left either in the glen or on the nearest mountains; it was only in the more sheltered places on the banks of the stream that brashy ice still remained, yet even these places were few and far between. The volume of the stream had also increased a good deal, and was then, I dare say, 12 to 14 cub.m.; it was running down its stony bed in a more and more continuous stream and with an increasingly hollower murmur.

Fig. 340.

After crossing over the height on which the masar stands, and passing a small square fortified wall, a stone house, and a yurt, we twice forded the stream at suitable shallows. That the river is sometimes impassable was clear from a wretched, neck-breaking rocky pathway along the slopes on the west side of the glen. The glen itself gradually assumes the character of a true transverse breach, piercing the wild and sterile masses of rock and growing narrower and narrower, while the crags on both sides rise higher and higher, as well as increasingly steeper. Every now and again they part to let emerge a side-glen through a rocky gateway. These generally form at their outlet a huge gravelly scree, radiating outwards like a fan and having its outer margin abruptly shorn off by the summer flood of the main stream. After that we had the river close at our right hand all the way, though

Fig. 341. KIRGIS CAMELS AT TOGHRA-SAJ.

Fig. 342. BOS-TSCHAT.

very often we did not see it, owing to its bed being cut so deep down through the gravel-and-shingle deposits; besides, it was screened by the terraces on the top of which, gravelly and strewn with stones, the track makes its disagreeable way. A typical section of this transverse glen is shown in fig. 340. The river is seen hugging the rocky wall on the right of the glen, and consequently on that side terraces are less frequent, and what there are are in every case fragmentary. On the opposite side however the terraces are all the better developed, and are often built up in two storeys. In some places however the river crosses over and presses against that side, forcing the path higher up on the slope, so that it is like a narrow cornice

directly overhanging the stream. The scenery is there picturesque and fascinating, and it appealed to us with all the greater force from our having just come down off the monotonous plateaus with their level horizontal features. Here however the predominant lines of the peripheral region are vertical, and give rise to constantly changing perspectives. Occasionally we came to a little expansion of the glen, with straggling bushes and tamarisks growing on the soft earth. By this the inclination of the glen had increased to such an extent that the river was repeatedly forming rapids and breaking into cataracts.

Two of the side-glens from the left are called Grütsch-karlik and Uj-bek; while on the slopes on the right is the grazing-ground of Abdur Rahman.

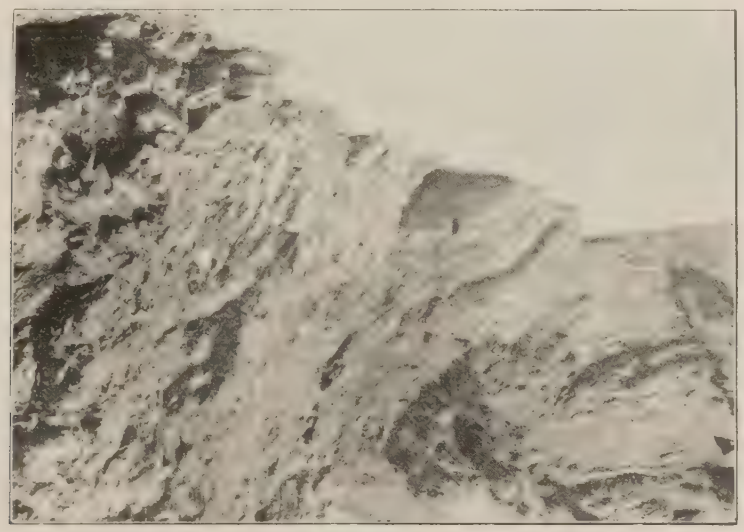


Fig. 343. ICE IN THE GLEN AT BOS-TSCHAT.

Then we came to an expansion known as Toghra-su, where the glen is joined by a large side-glen from the north-west, the brook in which carried about 1 cub.m. in the second. This glen of Toghra-su leads up to the pass of Karlik, on the other side of which is the district of Uschak-basch.

On the 1st May we did a short stage to Er Naser. On the day preceding we had descended 145 m. down to the Toghra-su (alt. 3473 m.), and after that we got down to regions with a more normal atmosphere. By this I had been seized with a most oppressive sense of weariness, so that I was scarce able to hold myself upright in the saddle; this I ascribe to the great changes in the pressure of the atmosphere to which I had been exposed during the last few weeks — from the sea-level up to the Kara-korum, and from that pass down to the lowlands of the interior, where the air is heavier.

The road was now fairly good, and we were mostly able to avoid those parts of the glen-bottom that are encumbered with fragments of granite. We kept entirely to the left side of the glen, not crossing the river once. This had how-

ever shrunk a little, partly in consequence of a fresh change in the weather: the sky was again clouded and at times a little fine snow fell.

In the outlet of the Kilian glen, up which you get an extensive view of the mountainous background, stands the tiny fort of Abu Bekr crowning a small knoll. An expansion of the glen, where bushes were growing, is called Pilat-aghatsch. Occasionally there was a little wretched grazing, on which goats were feeding, and every now and again we came across a yurt or a hut, around which the fields were being ploughed for the spring sowing. The glens which join the main glen, now on the one side, now on the other, were getting bigger and bigger, and not seldom contained running brooks. At the masar of Er Naser we halted, at an altitude of 3280 m. The place is also called Ali Näsär.

Fig. 344. STONE HUT AT BOS-TSCHAT.

On the 2nd May we had to ascend again to another pass, and went north up the glen of Bos-tschat, which, though it winds a good deal, makes no big bend to cause a loss of time. All the same the road was heavy, the glen being deep, narrow, and broken, and its bottom thickly filled with gravel and stones, which made riding difficult. The rocky walls rise on both sides to a giddy height, and are often nearly perpendicular. Here again the scenery is in a high degree grand and impressive. Every now and again we caught a glimpse, up this or the other side-glen, of the main range in the background, with its glittering snow-fields. In three places the bottom of the glen is so narrow and deep, that we were forced to ride

on steep ledges at the side. Occasionally a slushy sheet of ice still lay at the bottom of the glen. Bos-tschat is the meeting-place of two glens from the adjacent main range, each traversed by a spring-fed rivulet. At the actual conjunction of the two, the true Bos-tschat, stands a little stone hut. In the more westerly of these two side-glens were solid blocks of ice, while in the eastern prattled a muddy brook, which increased in volume towards evening. The rocks consisted for the most part of granite and mica-schist.

Fig. 345. CAMP AT BOS-TSCHAT.

On the 3rd May we had to cross the pass of Sandschu, which, like the Suget-davan, is so far of secondary importance that it only serves as water-divide between streams that belong to one and the same river-system. We started at 5.30 a.m., when nothing but the highest peaks were just tipped with the golden tints of the rising sun; in our glen the shadows lay diffuse and murky for several hours after that, and the temperature was fresh and pleasant, although chilly like that of a cellar. The weather was in every way favourable.

The glen still continued to be very narrow and deep, and its bottom was filled with blocks of granite and crystalline schist, so that riding was rather difficult and wearisome. Ever and anon we crossed over the stream, which was slightly frozen, but nevertheless kept up a faint murmur amongst the stones. At Tar-bughas or the Narrow Neck, which is a tiny expansion of the glen, a side-glen debouches from the east. The ground there was level and soft. Under the cliffs is an inclosure, in which caravans often take a rest before beginning the climb up to the pass. The glen winds with short, abrupt turns, principally towards the north-east; but its upper part, where the bordering mountain-walls decrease rapidly in altitude, is a good deal straighter. Here again snow made its appearance all at once and increased rapidly in amount. The dividing-line between bare ground and snow-covered

was so sharp that it was easy to suppose we were crossing a regular snow boundary. At last the shallow, trough-shaped glen ascends with extraordinary steepness towards the north-north-east. In front of us we now had the great crest in which the Sandschu pass forms a notch. The summit of the range was covered with snow, through which black, rugged pinnacles and denticulations peeped up here and there. The last portion of the acclivity is extraordinarily steep. The distance is only short, but you go straight up as if ascending a staircase. The gravelly surface of the sharp zigzag path was buried under the snow, but we kept faithfully to the track, which had been trampled down for us by the yaks. I was glad I had one of these sure-footed animals to ride on. All our Kirgis were on foot. They had urged so early a start in order that we might get up on to the pass before the snow began to melt, for that would have seriously impeded the passage. High above our heads we saw the caravan like a string of black dots; it was advancing so slowly that it appeared to be standing still, but gradually one black dot after the other disappeared over the brow of the pass.

Fig. 346. ON THE SANDSCHU-DAVAN.

This pass forms a very sharp ridge, overlooked by wild, scraggy cliffs of no great relative height. The altitude is 4977 m. Although the sun shone straight in our faces, it was stinging cold in consequence of the keen wind that was blowing. In every direction the scene was of the sublimest character. Towards the north, in the direction of East Turkestan, there was as yet nothing to suggest the lowlands: the distance was still too great, and the country filled with a host of fresh crests and minor chains, a world of mountains, ramifications of the northern border-ranges of the Kwen-lun system.

The descent from the pass on the north is if possible even steeper and wilder than the ascent on the opposite side. Down we went headlong through the snow,

VIEW FROM THE SANDSCHU-DAVAN.

VIEW FROM THE SANDSCHU-DAVAN.

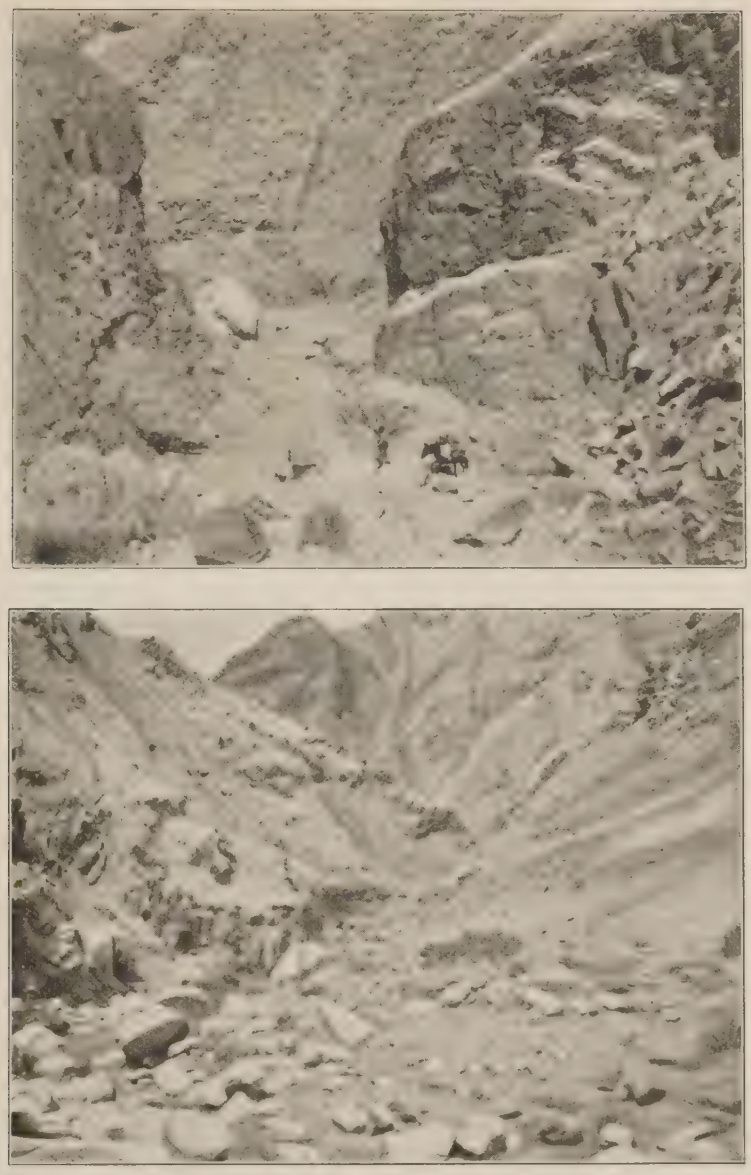


Fig. 347. IN THE GLEN OF BOS-TSCHAT.

a snag of rock sticking up here and there on our left as we descended. There was a greater quantity of snow on the north side, but from the base of the great gathering-basin it decreased again pretty rapidly. In the lower part of the great *Mulde*-like glen the bottom consisted of finely divided material and its slopes are seamed by a multitude of radiating mountain-torrents, which converge to form the stream of the Sandschu pass. The snow there, having melted, had given rise to a veritable clayey quagmire, in which even the sure-footed yaks kept stumbling.

After that the glen inclines towards the north-west and west-north-west, and at the same time the descent grows less steep, as well as drier, and the road con-

sequently easier. We kept to the right of the rather deeply trenched watercourse until we crossed over it just below the district of Sos. The locality above the ford is known as Gerem, a name pointing to the presence of one or more stone huts. The place where we encamped for the night is called Gäsgä-aghsi or Ghäza-aghsi; its altitude was 3208 m. There we found a hut and a tent, and fields in which corn is grown.

Fig. 348. VIEWS FROM THE SANDSCHU-DAVAN.

May 4th. The day before we had, as it were, passed from winter to spring; we now passed from spring to summer. Flies, gadflies, and insects of every sort now began to make their appearance. The sun beat hot, and the heat was reflected

from the faces of the cliffs; but as yet we could not complain that it was oppressive. It was with a feeling of congratulation that we turned our backs upon the severe wintry climate of Tibet, and rejoiced that there were no longer any snowy passes for us to be anxious about. Every trace of snow and ice had by this completely disappeared, both in the glen and on the surrounding mountains: there was not a streak of snow on the mountain slopes, not a speck of ice in even the most sheltered nook by the side of the stream. The temperature was no longer below zero; not even during the night did it descend below that value. It was only when we glanced up a transverse glen that we caught now and again a distant glimpse of white patches dotting a higher crest in the background.

Fig. 349. A TRAVELLING PARTY.

When we started in the morning to make our way down the glen, the stream was insignificant, about one cub.m. in the second; and it seemed ridiculous advice to give us, when the Kirgis urged us to make an early start, otherwise we should have difficulties to encounter owing to the gathering of the waters in the stony bed of the stream. But we soon saw the reasonableness of their advice, for the farther we descended, the greater grew the volume of the brook. At each successive crossing we noticed a difference, and we crossed over it pretty often. But then there is an unusual number of side-glens, and every one of these brought down a brook, either big or little, and each contributed its quota to the flood in the principal stream. The water in most of these was just muddy and of the same reddish brown colour as the sediment in the principal stream; it was only seldom that we passed a spring-fed brook with perfectly clear water and fresh sappy moss on its banks. In this way the brook went on increasing all day, until at last we found it rather uncomfortable fording it. This was however due less to the volume, which amounted to

about 8 cub.m. in the second, than to the peculiarities of the bed, which is narrow and filled with round, water-worn stones, often with deep water between them.

I noted the following names — Adschar-tughdi and Kulan-kujruk, parts of the main glen; Ghuldurghotsch, a side-glen from the left; below that the main glen is called Tallik, and there stands a stone hut; Kulluk, a large side-glen from the right; as also is Suget-aghsi. Kerelang-aghsi is another big glen from the left, in the upper part of which there are said to be wide, open grazing-grounds. Opposite to its outlet the bottom of the main glen is cultivated. Karaul, one of the usual simple four-sided stone-walled forts, was at that time inhabited by a Chinese *siáh*, whose duty it was to keep an eye upon the traffic by the Kara-korum route. Another side-glen from the right is known as Tam; at its outlet grow a couple of willows, and the fort beside them is said to date from »King Abu Bekr's time». After that the principal glen grows very narrow, and as the stream dashes quickly from one side to the other, we had to ford it no end of times. Tschong-tasch is an expansion in the glen, with cultivated fields and some Kirgis yurts. But before reaching that point we had already given up our yaks, it was too warm for them. A large side-glen from the right rejoices in the name of Jangagilik; in fact it is almost as big as the main glen, at all events in so far as the volume of its stream is concerned. At its head we saw the snow-capped principal range. A road is reported to ascend this big glen to the pass of Sandschu; it is used when our route is stopped by the water, but it is longer and climbs over yet another pass. We encamped at Akas-aghsi, at an altitude of 2547 m. There we were in the midst of pleasant meadows and cultivated fields; and there was a stone hut.

As the evening advanced, I noted that the Kirgis were quite justified in warning us against having to ford the stream late in the day. Through the contribution of the brook of Jangagilik the river had swollen to a very respectable size; but it was not long before it became absolutely impassable, even for the boldest *sutschi* or »waterman». At 2 o'clock we put down a watermark; at 3 o'clock the stream had risen 5.2 cm., at 4 o'clock another 15.0 cm.; at half-past 4 by 53.7; at 5 o'clock by 16.2; at 6 o'clock by 15.0; at 8 o'clock by 12 cm.; but at 20 minutes past eight it had dropped 3 cm., and it continued dropping all night. Thus it reached its maximum at about 8 p.m., and from 2 p.m. or in the space of six hours, it had risen not less than 117 cm., or more than 1 m. altogether; but I ought to add, that these measurements were taken at a narrow place. The quickest rise occurred between 4 and 4.30, the river rising in that half-hour more than half a meter. In consequence of the great amount of sediment that it contained, the river-water was like porridge, and the flood filled the glen with its noise to such an extent that we had to shout to make ourselves heard. It was truly an imposing sight to watch this immense body of water fling itself in uncurbed fury down its energetically excavated channel, choked as it is with stones. Every now and again we heard the big stones, which had been rooted to the spot for some time, tumble over and roll a little bit farther down the channel. As the torrent struck against these obstacles, it leapt up over them a like wild animal. Upon witnessing such an exhibition of natural force, you readily understand that it must produce results of some magnitude and that the glen it pours down must be deeply excavated; although, as the

Kirgis declared, it was only five days before that the river had assumed the dimensions of a spring-flood, a character which it would retain for yet two months longer. This unusual energy is therefore restricted to a relatively short period of the year. And although both before and after that season the river is not indeed altogether insignificant, yet in comparison its volume is but trifling. During the cold months it is frozen and its activity is then *nil*. When the flood is highest, which it would be about three weeks after our visit, it is said to rise a meter higher than it stood at then, and is indeed an immense flood, stopping the glen completely. That year the high water was said to have arrived earlier than usual, and that was considered to be a great gain for the seed-corn sown at Sandschu, where the fields were all ready waiting for the life-giving element. As a consequence of the unprecedented quantity of sediment and clay with which it was charged, the water was of precisely the same colour as the neighbouring mountains, so that the stream and the bottom of the glen were not very conspicuous features of the landscape. Indeed the river was only noticeable because it moved and had a broken surface. It had no white foam; but where it did boil and froth, it still remained the same brownish-red as before. The sediment imparted to the river a strong odour, similar to that which emanates from the walls of a freshly plastered house. This sediment is also an eloquent witness: it consists partly of material brought down directly by the many thaw-water streams and partly also of fine material produced by the grinding together of the stones and gravel in the bed of the principal stream, and by the friction of the moving detritus against the bed of the river. In any case it is the result of disintegration and attrition, and is carried down out of the mountains to be deposited on the edge of the lowlands, where it serves to raise the scree at the northern foot of the mountains, on the border-line between the mountains and the lowlands of East Turkestan.

It was impossible to form anything approaching a trustworthy estimate of the volume without the help of a bridge, from which alone measurements could have been made. Next the right bank the velocity amounted to 1.25 m. in the second, but in the middle of the river it was a good deal more. Bearing in mind the severe friction against the stones and gravel in the bottom of the river, we may put the mean velocity at a meter in the second. The breadth was 24.6 m. and the mean depth fully 1.40 m. This last datum I obtained by measuring the mean depth on the following day, when the flood had subsided sufficiently, and then adding to it the height of the actual flood. On the basis of this calculation, the volume would therefore be 34.4 cub.m. in the second; it is however probable that the velocity in the middle of the river and throughout the greater part of the breadth was as a fact greater than 1 m., so that we ought rather to put the volume at about 40 cub.m. in the second.

On the 5th May the Kirgis asserted, that there was no need whatever to be in a hurry; we should not be overtaken by the flood. On the contrary, it would be an advantage to wait, for the river would go on dropping all the morning; and indeed between 8 and 9 a.m., for instance, it did drop a good decimeter. Yet even when near its minimum, it made a fairly respectable stream, so much so that I was in some anxiety with regard to the more perishable part of my baggage. If a

baggage animal were to fall in that quagmire of clay, and its burden to get loose, it would scarcely be possible to fish it out again; the water was so thick and muddy, it would be impossible to see where it lay. The real difficulty in fording the river arose from the fact that the animals were unable to see where and how to put their feet; before they durst take another step, they used cautiously to feel their way with their feet. As a rule the camels were surer of themselves than the horses. Here we dismissed the horses which we had been using for some days and transferred their loads to the backs of camels. Not once did any of the latter animals fall or stumble whilst fording the river, though one or two of the horses did, yet without any serious consequences ensuing.

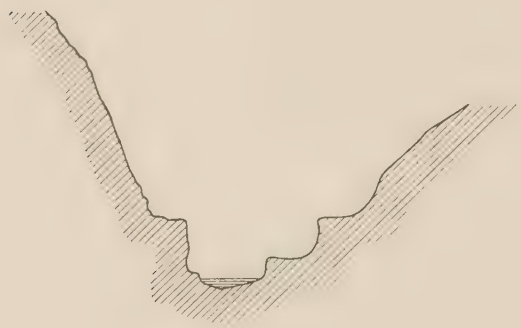


Fig. 350.

Next morning the weather was of the most peculiar and unusual character. The temperature was agreeable and there was no wind; but the glen was filled with an impenetrable mist. Upon first seeing it, we naturally concluded that it foreboded the approach of a tempest, and that snow was falling on the mountains; but the Kirgis called it *topa jaghadi*, or »dust raining». It appeared that the so-called mist was perfectly dry, and was composed of fine dust floating in the atmosphere, having been blown up by the winds of East Turkestan, the usual desert winds of the spring, a phenomenon of which we had more than enough experience in the lowlands. Beyond doubt a tempest was raging down there just then, and it was very interesting to observe that its effects, in the shape of the fine drift-dust that hovers so long in the air and in certain districts gives rise to loess deposits, penetrated as far as that up the border glens. So dense was the dust-haze that, upon looking up the glen, we were unable to perceive a glimpse of the mountains; all that we could see was the very faint, diffused outlines of the nearest mountain-walls on both sides of the glen. But we got the impression, especially after we advanced farther down, that the stratum of the atmosphere nearest to the surface of the earth, that is to say, in the bottom of the glen, was much less heavily impregnated with dust than the strata higher up.

The glen is remarkably picturesque, being deeply trenched between vast mountain-masses, as well as exceedingly contracted, and frequently its profile was as shown in fig. 350. Gradually the scenery that unfolded itself assumed a wild and fantastic aspect; precipitous buttresses leapt forward from the chains at the side of the glen one after the other like the side-scenes of a theatre, and behind each of these appeared a fresh view, the background of which soon vanished however in the dust-haze. Against the foot of these precipitous cliffs are banked vast gravel-and-shingle terraces with abrupt sides; in fact they sometimes overhang and threaten to fall. The bottom of the glen itself is exceedingly deep and narrow. The stream clings first to the rocky wall on the right, then to that on the left, compelling us to cross it repeatedly.

At the beginning of the day's march these crossings came close together. Before we reached the glen of Ochur-terek on the right we had already forded the river eleven times. Between Akas-aghis and the place just mentioned I recorded the following names: — Alka-tasch, a side-glen from the left; Turumduk, a side-glen from the right; Buschlang, another from the left, up which we ascended a little way and then returned to the main glen; at its outlet is a stone hut. Down this glen a dark-brown torrent was churning its way. It is near this point that the main glen is called Ochur-terek. At Mollah Baj-kija we forded the river for the twelfth time, the crossing being very difficult and risky, owing to the fact of the stream being concentrated into a single deep channel, shut in by gravel-and-shingle terraces, 15 m. high and for the most part perpendicular, though a steep path runs up and then down to the water's edge. Another side-glen from the right is Kurughas; in its upper part are *jajlaks* or grazing-grounds. All these side-glens were traversed by torrents, often of pretty large size, and the colour of their water indicated that they descend to the main stream more rapidly than the main stream itself does; indeed the latter was steadily rising again in consequence of all these successive augmentations.

Before we reached Kendis we forded the river yet three times more. At Kara-kija there exists a steep pathway over the rocks on the left which horses could use, though camels have to cross over the stream twice. After having cut its way through these cliffs, which consist for the most part of mica-schist, the glen again widens out. From the left debouches the large side-glen of Telve-tschuke, with a considerable torrent; while a similar glen, Jätim-jilgha, opens out on the right. After we passed Kovoghane-jilghasi on the left, the glen grew very much more open, the mountains receded; but the entire country was shrouded in the dust-haze, the light faint, the sun not visible at all, but we could not very reasonably complain of the heat. Kirk-umöj, or as others pronounced it Kirk-omöngö, is the name both of a village in the main glen and of a side-glen that enters from the left. On the right bank of the river stands a *gendeng*, or guest-house. Soon after that the first *baghs* or orchards, with poplars and willows, made their appearance, the trees being then dight in all the glory of their fresh spring greenery. Above that point the only vegetation that the glen could boast of consisted of balghun and other thorny bushes, scrub, and grass. The farther we descended the thicker and the more luxuriant grew the grass.

The glen inclines to the north-north-east, and we forded the river yet three times more. A right-hand side-glen is called Atschik. Here we kept all the time to the right of the river, having the foot of the mountains close to our right hand. The last side-glen from the right bears the name of Tevet-jilgha, and its almost black-brown torrent may easily have carried 5 cub.m. in the second: it was the largest contribution that the main stream received all day, the next largest being that of the torrent of Telve-tschuke. The former, the torrent of Tevet-jilgha, was rushing down with unbridled fury and was anything but easy to cross over, especially as its channel was very deep. The glen still continued to widen out, at the same time that the mountains not only receded more and more but also grew simultaneously lower and lower. The last side-glen on the left is Jigdelik-khas; it

debouches over against Kenki, a village of 8 or 9 steadings, surrounded by orchards and fields, where we encamped for the night. Amongst the fruits cultivated are apples, pears, peaches, and mulberries; while the other crops embrace wheat, barley, melons, and so forth. Besides these things we were offered carrots, turnips, onions, and other vegetables, and poultry and eggs were to be had in abundance. We were again in East Turkestan, in a milder and more hospitable climate; but the absolute altitude was now only 2200 m.

After granting ourselves a day's rest, we resumed our march down towards the lowlands. The dust persisted through both the 6th and the 7th May; indeed on the latter of these two days it was thicker than ever. In addition to that the wind blew strongly from the north, and the natives declared, that one of the usual *sarik-burans* was raging in the lowlands; for when a kara-buran is blowing the haze is wont, even so far up, to be a good deal thicker than it was then. They look upon the cuckoo as a sure weather prophet, for he always sings in a distressed note when a buran is coming on. The inhabitants of the village of Sologhas, situated farther down — in fact the place does not belong to our glen, but is entirely dependent for its drinking-water upon that derived from the melting of the snows — assert that hazy weather like that which then prevailed is favourable for the crops, because at such times the river flows uniformly and regularly, and consequently the water admits of more even distribution, and so is more beneficial to the fields. On bright and sunny days, on the contrary, the thaw-water flows much too rapidly and in too concentrated a stream to allow of its being utilized to full advantage. The numerous villages which during the course of the day we were to pass in the big glen that runs down from the pass of Sandschu are in this respect less dependent upon the river; for, as we learnt, that part of the glen is supplied, even when the sky is clouded, with an abundance of water, derived from mountainous districts into which the dust-haze and its effects do not penetrate.

The name Kenki or Kengri has reference to the breadth of the glen, although some ventured to assert that it is a corruption of Chaneka. From that point we continued our journey down the glen with a new supply of fresh horses, keeping to the right bank and passing in succession the villages of Sälpütsch (with three steadings), Dovalik (5 steadings), Kum-arik, Kisil-basch, Isme-sala, Ara-jangal, Toghöjlik, Savo (100 steadings), Kajtschile, and Dung-tscheke. The villages followed one another so thick and fast that at last it was as though we were riding through a continuous street or along a highway with long grey walls on each side of it. Of the other villages in the glen I will mention Tschakende-aghil, Tschamgor-tagh, which is said to be situated near to Kenki and to consist of 300 scattered steadings; Sejtlar, Baskak, Tägirmän-baschi, with a large irrigation canal going to Sanguja; Tschäsgham; Siklik with a *lenger* or guest-house; Dung-bagh; Basch-kantschi, with four steadings; Masar Danisch Bende, with two steadings; Baghlar, with 150 steadings (or *ujliks*); Saj-bagh, of the same size; Tschüdar, with 100 steadings; Tschahr-vagh, with 150; Moköjle and Mudschi. This is not however a complete list. Several of these villages belong to the large oasis of Sandschu. Yet all belong to the glen that runs from the Sandschu-davan and finally divides into the two glens of Mudschi and Sanguja, whereupon the river breaks up in deltaic fashion before it finally be-

comes lost in the sandy desert. Hence the hydrographical value of the three passes which we last crossed over is as follows. The Kara-korum separates the Schejok from the Jarkent-darja; the Suget-davan is the water-divide between the Jarkent-darja and the Kara-kasch-darja or Chotan-darja; and the Sandschu-davan the water-divide between the last-named and the Sandschu river. This stream, which in point of extent cannot in any sense compare with the first two, nevertheless carried, as we found, incomparably the bigger volume; this is because its drainage-area falls for the most part within relatively lower parts of the mountainous country, in which the snows were just then melting rapidly, whereas it was in its source-region that we struck the Jarkent-darja and whilst deep winter still prevailed, but we struck the Kara-kasch in the middle of its course, where also it was again cold.

The glen of Sandschu gave the impression of being very prosperous and well-to-do; the soil, which consists of hard yellow loess deposits, is undoubtedly rich. Against the everlasting yellow background the trees offer a sharp contrast with their thick, fresh green foliage. Amongst the willows grow many fruit-trees, and here and there we caught glimpses of the vivid green of meadows and fields. Thus the glen is, as it were, braided with two ribbons of green and between them flows the river, with the life-giving element, which imparts to them of its superabundance through the instrumentality of innumerable irrigation channels. All the people were looking forward to a copious harvest, and everybody was glad.

At the village of Kurghan we left the river, and at Dung-tscheke we changed the direction of our march from north-east to north-west. By this the glen had already opened out trumpet-wise and lost its mountainous character, as it now sloped with increasing gentleness north-eastwards down to the villages of Sandschu. We climbed up over the hills on the left side of the glen, though we hardly saw them owing to the thickness of the haze. They are composed entirely of soft material — gravel-and-shingle detritus, reddish yellow very spongy clay, and sand. The road then ran on the right-hand side of a watercourse that breaks abruptly down to the river. This stream issues below Dung-tscheke and only carries water after rain. Soon we reached the top of the little secondary pass Savu-davan, having an altitude of 2206 m. On the other side of it, or to the north-west, extends a sort of flat plateau, with stretches of very low hills running from south-west to north-east. It is in fact a slightly undulating steppe without a drop of water, very often indeed with dry watercourses: there is not a single rill to show that it ever rains. And yet there was a sprinkling of steppe plants, and the antelopes sometimes flitted like phantoms through the haze, leaving a long trail of dust behind them. There was a good deal of sand on the surface of the ground, and here and there we observed the first small beginnings of dune formations.

A path leads off to Ghuma a short distance north-west of the top of the pass; but it was swallowed up in the haze; indeed so thick was this that there was nothing to suggest the proximity of the lowlands. We had now left behind us the rich and luxuriant vegetation of the banks of the Sandschu river, which had been invisible to us since we left the pass, and had emerged upon the actual desert. And for a pretty considerable distance our surroundings continued to be the same, the uniformity of the route being relieved by only two stone »signposts» at places

called respectively Tschonak-tasch and Majmun-tasch. It was with a feeling of genuine pleasure that we at length saw the poplars and willows of the tiny village of Sologhas looming up through the haze. An idea of this little oasis is conveyed by Pl. 43 of vol. II. It only gets water when the snows melt and when it rains, so that its annual harvest is somewhat precarious. If no snow falls in the upper part of the glen which sends its brook down past the village, and on farther to Mok-ujle, and if no rain falls in the spring, the harvest of the villagers is totally ruined. Both 1900 and 1901 had been fortunate years for them in this respect; but farther back than that they were unable to recollect how they had fared with regard to water-supply. When, after a dry period, the water again begins to flow down the

Fig. 351. TWO OF OUR TRAVELLING COMPANIONS. THE SHEEP ON THE RIGHT ACCOMPANIED US THROUGHOUT THE WHOLE JOURNEY OF THREE YEARS.

bed, the people hasten to direct the earliest freshets into the *köl*, or artificial basin, which is seen in the foreground of the photograph just mentioned, and it is only when that is completely full, and thus their reserve supply of water is ensured, that they allow it to be distributed over the fields. When I was there, the basin had just been filled to the brim. Indeed the oasis itself is situated in the depression which has been created by the fluvial erosion. The ten ujlik in the village all belong to one and the same family. The altitude above sea-level was 1822 m.

May 8th. The haze had lifted and the wind dropped, so that the atmosphere was clearer and we were able to see a good half hour ahead. It was likewise warmer, though the heat was by no means oppressive until the afternoon, when it again began to blow a little from the north. Monotonous uplands now stretched before us to an infinite distance, the surface being but slightly undulating in long flat billowy curves, which were only apparent in consequence of their striking difference of colour in the still obscure atmosphere. The watercourses which we passed

during the course of the day had rounded terraced banks on the right or east only; on the opposite or left side the country was everywhere flat and level, this difference being, I dare say, connected with the tendency which the East Turkestan rivers manifest to shift to the right.

After crossing over the stream of Sologhas, then divided into several arms, we came out upon level, stony steppe. Lajdang and Ile-tasch are the names of a temporarily inundated area and of a »sign-post» respectively; while Ighis-tasch is the name of the double terrace which borders the stream of Kosch-tagh on the right, this being a fairly important stream, which derives its water from the adjacent mountains. The name of the brook Kara-su indicates that it is fed by springs, and the bed is in relation to the volume so very large as to suggest a continuous flow. The water was being then distributed over the rather extensive fields of Kosch-tagh. This oasis wore a greater air of prosperity and fruitfulness than even that of Oj-toghrak. After crossing over two other streams in the western outskirts of the village we again emerged upon barren steppe.

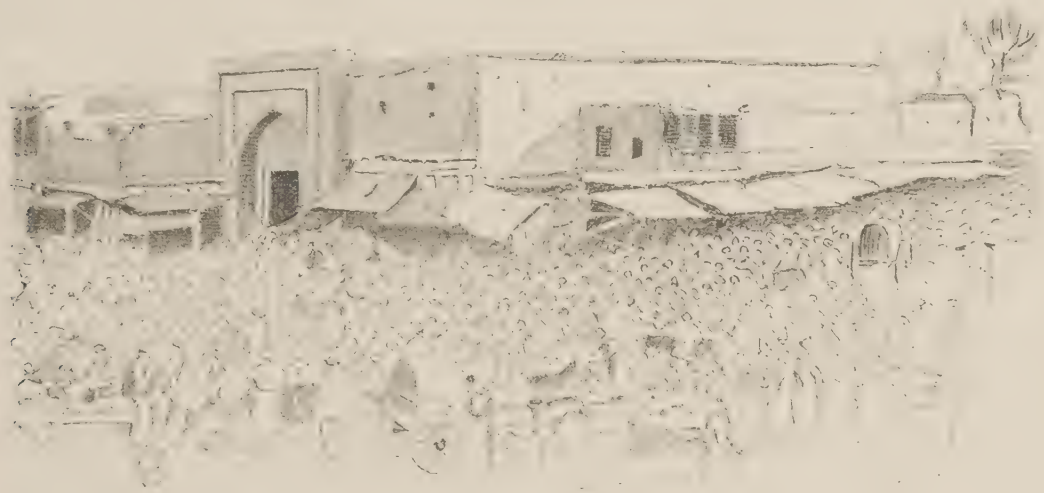


Fig. 352. THE MAJSUD BAJ AND REGISTAN OF KASCHGAR.

An hour later we forded the river of Kilijang, which comes from the same range as the Sandschu river, rising on the Kilijang-davan or Kilian-davan, situated not far west of the Sandschu-davan. This stream was then carrying a total volume of 15 cub.m., divided amongst five arms. It waters the oasis of Ghuma, and is very broad, with terraced banks on both sides. Travelling along the top of the terrace on the left, we crossed over a little canal, which approached that spot from the village of Sasam, which we saw a short distance away. The next barren steppe that we came to is called Bo-jigde; and it is followed by another branch of the stream known as Pischil-akin, and then by the insignificant brook of Takla-makaning-darjasi. Higher up, on the left of our route, we observed in several places groves of poplars and orchards, belonging to various small villages or hamlets, *e. g.* Basch-lenger and Hassan Bughra Padschahim. Then, after crossing over yet two other watercourses, though they

had no water in them, we went straight down a steep sloping terrace to the oasis of Oj-toghrak. This oasis, which is situated in a fairly well defined watercourse, bordered by hills, makes a pretty picture when seen from the top of the barren terrace, embowered as it is in refreshing greenery. The vegetation was here considerably more forward than in Kenki; the poplars, willows, and mulberry trees all afforded plenty of shade. Of the mountains to the south we did not get one glimpse, notwithstanding that they were so near to us. I can quite excuse Marco Polo, who travelled by the southern caravan route, for not saying a single word about any mountains to the south. It is very probable that he did not see them owing to the atmosphere being heavily charged with dust, so that he may not have had the slightest suspicion of their presence; although, on the other hand, the direction in which the streams flow might have suggested the fact to him. All the way down to Oj-toghrak the water is derived from the Kilijang-darja, which upon emerging from the mountains appears to spread itself out like a fan over an extensive scree. Oj-toghrak lies 1820 m. above sea-level.

It only remains to describe our last day's march, namely the road from Oj-toghrak to Karghalik, which we traversed on 9th May. We crossed the stream of Oj-toghrak by a bridge, and for a space climbed up hills of detritus and loess until we came to a small threshold pass. After that the surface was practically level or but slightly undulating, and with the exception of thin scrub it was barren and desolate. Names occurring along this section of the road are Bel-kum, Sook-ghas, and Bujra-könäsi. From the last-named locality you go down to Bujra-kent, quite a large oasis with beautiful orchards, lying in a glen with a deep-sunk winding watercourse, which we crossed by a bridge. The ascent up to the terrace on the other side is rather steep. On our left we passed the village of Buksängö. Then followed yet another barren steppe, with scrub growing amongst sand and dust. This locality is called Kivun. The brook of Buksängö waters Bisch-arik, which is reached by a path from Teng-jaghatsch. The large glens which we crossed along this part of the route hardly reach all the way down to the great caravan road, and in any case it is seldom that their brooks get down as far. Thus the river of Bujra-kent reaches as far as Akin-lenger and Kosch-lenger and that of Oj-toghrak to Tschulak-lenger.

At last we reached the village of Lenger, where we were met by the beks of Karghalik. Here the Uschak-basch distributes its water through several branches, the basins of which are separated from the stream of Kok-jar by a strip of desert. Then, having crossed over the last-named, we entered amongst the orchards of Karghalik, and once more found ourselves at an altitude of only 1341 m.

I then journeyed to Kaschgar by way of Jarkent, Kisil, and Jangi-hissar, a route which I have already described in *Petermanns Mitteilungen*, Ergänzhft. No. 131.

EXPLORERS' JOURNEYS IN HIGH TIBET

CHAPTER XXVII.

PRSCHEVALSKIJ'S FIRST AND THIRD JOURNEYS.

It is not at all my intention to discuss all the journeys that have been made in Tibet. My plan does not require any such history of Tibetan exploration, and it would indeed be superfluous, for the earlier journeys in that part of the world, and their results, have been critically dealt with by von Richthofen in the first volume of his *China;* and as for the later journeys, it will be sufficient to refer to the different travellers' own works and the accounts of them which have been printed in various geographical journals. Besides, brief comprehensive résumés are to be found in Dr. Georg Wegener's *Tibet und die englische Expedition* and in Graham Sandberg's *The Exploration of Tibet, its History, and Particulars from 1623 to 1904*, as well as in one or two of the books that have been published by members of the English Tibetan mission to Lhasa, and with regard to which I shall have something to say later. Further, in my opinion the time is not yet ripe for an exhaustive historical account of that country; for there is reason to believe that Tibet has now at last been opened up to systematic exploration, and that the time is not far distant when we shall know the broad features of its geography, and nothing will remain to be done except the diligent and painstaking study of details. To attempt, in the light of the experiences which have been gradually accumulated in the course of time, to sketch the outlines of the orographical structure of Tibet, and its hydrographical and hypsometrical relations, and so forth, would in the mean time lead to erroneous results, because several parts of the country of special importance for geography are but little known or not known at all. I need only mention the great lacustrine region in the centre, which Nain Singh hurriedly mapped, the country immediately north and south of the Tsang-po, the northern valleys of the Himalaya, the peripheral region of eastern Tibet with the transverse glens or »breaching» defiles of the great Indo-Chinese rivers, as well as, finally, immense areas of the central highlands, which have never yet been crossed even by the pioneers of exploration.

In the present chapters I shall therefore confine myself to a few remarks about the journeys that fall within those parts of high Tibet which I have myself visited. These amount to an area of very considerable extent, but are just those parts that

have been most neglected by explorers. Several travellers have touched Tibet on the north-east and on the west, and through the journeys of the Indian pundits we have long had a fairly clear conception of southern Tibet, at all events of certain portions of it. But the parts of the high, inaccessible Tibet which I made it my object to explore, namely the region bounded by the Kwen-lun on the north, the central lacustrine area on the south, the Kara-korum route on the west and long. 91° E. Greenwich on the east, has been visited only by Nain Singh, Krishna, Prschevalskij, Carey, Pjevtsoff, Bonvalot, Littledale, Rockhill, Dutreuil de Rhins, Wellby, Bower, Deasy, and Rawling, and to these must be added certain journeys in the peripheral parts, *e. g.* the Kara-korum route, which has been traversed many times, and the districts around the Panggong-tso. Yet some of the travellers whom I have just enumerated have only in part touched the region thus defined. Really extensive journeys on the Central Tibetan highlands have been carried out only by Nain Singh, Krishna, Bonvalot and Orléans, Dutreuil de Rhins and Grenard, Bower, Wellby and Malcolm, Deasy, Littledale, and myself. It is in the material which these explorers have brought home with them that we can alone hope to find points of contact with my journeys. But the journeys of such important travellers as Count Széchenyi, Roborovskij, Holderer and Futterer, Kosloff, Bonin, Filchner and Tafel, and several others lie entirely outside my purview. In his *Versuch einer Orographie des Kwenlun* Dr. Georg Wegener has published an excellent map of all the journeys in Tibet which have touched the Kwen-lun Mountains and which date from before 1891. But it does not of course embody the journeys which have been carried out during the last fifteen years, journeys which are calculated in an especial manner to throw light upon the orographical structure of the Kwen-lun and the character of the highlands of Central Tibet.

But let us proceed to examine the journeys which possess interest for us, and which can furnish us with the requisite material for a comparison. I will begin with Prschevalskij's first, and perhaps his most remarkable, journey in Central Asia, in the years 1870—73, by quoting a couple of extracts which have to do with Northern Tibet. Although that part of his journey lies really outside the region I have defined, still the following passages will justify my quoting them in this connection.

Prschevalskij first penetrated Tibet from the Koko-nor and Tsajdam. The observations which he then made, in so far as they are of general geographical interest, are reproduced in the following greatly condensed account: »Between the lake of Toso-nor (Tosun-nor) in the east and the river of Nomochun-gol in the west stretches the mountain-range of Burchan-Budha, bordering the high plateau of Tibet on the north. In the course of 30 versts this range gradually rises to an altitude of about 4660 m. and on its southern side sinks slowly down towards the valley of Nomochun. It is only near the crest that the ascent is steep; yet notwithstanding the considerable altitude, the summit bears no perpetual snow and it is only in the east that it touches the snow-line. When we visited the same region in November we found a mere sprinkling on the northern versant only; but when we returned that same way in February we failed to perceive any trace of snow, even in the glens. The Burchan-Budha range forms a natural boundary between Tsajdam and

Tibet; to the south of it the plateau reaches an altitude of 4000 to 4600 m. and still farther in the same direction it certainly attains an even greater altitude. Vegetation is extremely scanty on this range, and as a consequence of that animal life is also scarce. Still there are some brooks and grazing-grounds on the south side of the range, to which the Mongols drive their herds in summer to escape from the insects of Tsajdam. Only two larger streams force their way through the Burchan-Budha, namely the Nomochun-gol and the Alak-nor-gol (Alang-nor), which come from the Tibetan highlands, and after piercing the border-range empty themselves into the Bajan-gol of Tsajdam.

On the south side of the glen of the Nomochun stretches the Schuga range, parallel to the Burchan-Budha. Both ranges exhibit the same physical appearance, but the former attains to a somewhat greater altitude and possesses five peaks that reach the limit of perpetual snow. On the west it terminates abruptly over Tsajdam; but in the east it is connected with the mountains out of whose southern flank the Schuga-gol issues. Its glen, like that of the Nomochun, is surrounded by relatively fruitful grazing-grounds.

A hundred versts south of the Schuga Mountains we find on the left shore of the Mur-usu, the range of Bajan-chara-ula and its westward continuation, the Kokoschili range, forming the water-divide between the Blue and Yellow rivers. The Bajan-chara-ula, unlike its northern neighbours, does not exhibit such angularity of outline, reaches a lower altitude, nowhere touches the snow-line, abounds in streams, and is fairly rich in vegetation, but preserves the same direction that they do, namely west-north-west and east-south-east.

Between the Schuga and the Bajan-chara-ula stretches a terrible desert with in the north-east the Gurbu-nadschi Mountains, forming the eastern outpost of the Kwen-lun system. In this desert there is an almost total absence of vegetation. Here and there deep grooves in the thick powdery surface furnish evidences of the violence of the tempests. The climate is in perfect agreement with the harsh character of the region — in winter stinging cold and furious tempests, in spring snow-storms, in summer rain and hail; it is only in winter that the weather is calm and mild.

The two and a half months that we spent in the Tibetan deserts were the most toilsome of the entire journey; at night the temperature dropped to — 31° C. Snow fell very rarely and then only in small quantities; it was dry and fine like sand. Besides the slight amount of snow and the severe cold, another characteristic of the Tibetan winter is the sand-storms. These come from the west or north-west with at first a gentle wind, which gradually increases in force until at last it blows a perfect gale. The sand and dust are whirled up like smoke, making the sky grey and preventing the traveller from seeing the outlines of the mountains at more than a hundred paces' distance. When these sand-storms come on, the temperature always rises. At sunset the storms cease, but the fine dust hovers for some time longer in the air and next morning the atmosphere is still a yellowish grey.

After passing the Bajan-chara-ula we at length reached, on the 10th January 1873, the bank of the Jang-tse-kiang, or Blue River. This stream, known to the Mongols as the Mur-usu and to the Tanguts as Dij-tschu (Du-schu), rises in

the Tang-la Mountains, flows across the highlands of northern Tibet, and waters China proper, where it soon assumes gigantic proportions. Its flow is very rapid.

At the confluence of the Naptschitaj-ulan-muren its breadth reaches 228 m.; but in the summer, during the rainy season, it is four or five times as big. Its valley is however only 2 versts broad, and through it runs the road to Tibet, keeping beside the river almost all the way to its sources in the Tang-la Mountains. The Blue River formed the limit of our journey in Central Asia.»*

In his third journey (1879—80) Prschevalskij traversed a considerable part of north-eastern Tibet, but also to the east of my itinerary of 1900. If we confine the term Central High Tibet to that part of the country which possesses no outlet to the sea, then Prschevalskij did not, on this occasion either, touch the region in question, but he kept principally to the upper basin of the Jang-tse-kiang. Prschevalskij summarises the general characteristics of the physical geography of north-eastern Tibet in the following words: »The Tibetan mountain ranges are distinguished by the following properties: they run parallel to one another from east to west, and notwithstanding the great height above the sea the individual peaks reach but an insignificant relative altitude. Setting aside the snowy summits, they form dome-like swellings, with gentle gradual slopes. The mountains consist generally of gravel, sand, limestone, and schists. Snowy mountains occur in the Tang-la and Marco Polo ranges, and also on the mountains between these ranges and beside the upper course of the Yellow River. The lower glacier margin coincides here, as it does on the Nan-schan Mountains, with the mean snow-line. According to our observations, the latter begins on the Tibetan mountains at an altitude of 4950 to 5100 m. Between the mountain-ranges stretch plains with a clay surface. There are no loess formations of any extent, and drift-sand is equally scarce. On the other hand saline formations are common. The water, including sometimes even the water of the rivers, has a brackish taste. The lacustrine region extends from the Tengri-nor to Lake Panggong. In the eastern part of the high plateau rise the Hwang-ho, the Jang-tse-kiang, and in the south-east the two Indo-Chinese rivers, the Salwen and the Mekong. The north Tibetan rivers mostly flow towards Tsajdam and generally terminate in salt marshes. The streams which have their sources on the northern slopes of the Tang-la, the Dung-bure, the Koko-schili, and the Marco Polo Mountains, empty themselves into the Mur-usu (upper Jang-tse-kiang).

As for the climate, the result of our hasty observations goes to show that, notwithstanding the southerly situation, there exists a remarkably low temperature, violent tempests, great aridity of atmosphere in the spring, autumn, and winter, and heavy rains in the summer. The low temperature is explained by the great altitude of the country and by the fact that it is bordered on all sides by lofty mountains, in part snow-clad. In spring and summer rapid changes of temperature take place. The autumn is the best season of the year in Tibet, for the atmosphere is then for the most part clear, the temperature equable, and storms seldom. The late autumn is mild, but the winter cold. Although snow falls very frequently, the amount is insignificant, for it is soon swept away by the storms or melted by the sun. The

* *General Prschevalskij's forskningsresor i Centralasien*, Swedish translation by Sven Hedin (Stockholm, 1891). — N. Prjevalski, *Mongolie et Pays des Tangutes* (Paris 1880).

tempests that are characteristic of Central Asia prevail also in Tibet. They come for the most part from the west, beginning at noon and lasting until sunset. They are extraordinarily violent. In February, May, and June they rage almost every day. They are in part caused by the great difference of temperature that obtains between the Tibetan high plateau and China. The rainfall is dependent upon the monsoons. The influence of the Indian monsoon extends across the Himalaya and over northern Tibet, and we observed that within that region the rains accompany the west-south-west storms, while within the sphere of the Chinese monsoon they accompany south-easterly storms.»

Next I add a few excerpts dealing with the course of his journey. »On 12th September 1879 we started from Tsajdam to travel into Tibet. Instead of climbing over the lofty Burchan-Budha, we chose the route through the glen of Nomochun-gol. In order to reach it we had first to cross over an infertile plain, where salt marshes alternate with *charmik* and tamarisk steppe. Still even there we came across a patch of ground cultivated by poor Mongols. I found the Burchan-Budha just as wild and infertile as before. The Nomochun-gol was then only 9 to 12 meters broad and 30 to 60 cm. deep. Its bed has cut through loess deposits and layers of gravel-and-shingle.

Two days' journey from Dijnsij-obo we struck into the road which I traversed in the year 1872—73, namely the road over the Schuga Mountains, which there reaches an altitude of 4560 m. Its northern slopes were already covered with snow. We found the Schuga river was fairly full of water. It pierces the range in a north-westerly direction, flows across large salt plains, and finally empties into a salt lake in Tsajdam.

Two mountain-passes lead across the Marco-Polo range, Tschum-tschum and, farther west, Angijr-daktschin, and of these we selected the former. Notwithstanding the considerable altitude of 4970 m., the passage was fairly comfortable. There are no wild cliffs, and the mountain-slopes abound in green vegetation and game. By this we had reached the Tibetan high plateau. Our guide led us along a little brook, which appeared to join the Naptschitaj-ulan-muren, a tributary of the Mur-usu. There we lighted upon old caravan camping-places, which had probably been made by pilgrims to Lhasa. On the 4th October the ground was covered with a sheet of snow 20 to 25 cm. deep, and the thermometer dropped to — 9° C.

Every now and again we rested a day in places that offered grazing for our outworn animals. We had difficulty in finding the road, for the snow obliterated the trail of the caravans which had previously travelled that same way. The next plain that we crossed is that which stretches between the Marco-Polo range and the Koko-schili range and lies at an altitude of 4200 to 4500 m.

The latter range attains in that part an absolute elevation of 4800 m. above sea-level, but a relative altitude of only 600 m., nowhere reaching to the snow-line. The mountains there are dome-shaped and their slopes grassed; otherwise the vegetation appears to be scanty. Between the Koko-schili and the Dung-bure chain stretches a high plateau about 4500 m. above sea-level. The crossing of the Chaptschik-ulan-muren, probably an affluent of the Mur-usu, occasioned us great

difficulties. The river was, it is true, frozen over, but the ice was not strong enough to bear our camels.

After that we penetrated into the Dung-bure. This range, which in every respect resembles its neighbours, rises above the snow-line in a few places in the east only, and on the south is connected with the rocky chain of Tsagan-obo. On the slopes of Dung-bure there exist grassy, marshy places, where wild yaks love to graze.

The Mur-usu, which we now luckily approached, flows in a north-easterly direction to the confluence of the Naptschitaj-ulan-muren and then towards the south-east. When in flood it reaches a breadth of 80—126 m., but after picking up the Naptschitaj-ulan-muren it is very much broader. In places the depth reaches 1.5 to 2.1 m.; its velocity is great, and its waters of a blueish colour. It is full of fish, but is frozen from November to March. Its banks are relatively rich in vegetation and for Tibet the pasture-grounds are even good. The first two tributaries, the Toktonaj-ulan-muren and the Naptschitaj-ulan-muren, join the river from the left, and on the same side stand the mountain-ranges of Tsagan-obo, Dung-bure, Koko-schili, and Bajan-chara-ula.

South of the Mur-usu we reached the highest part of the Tibetan plateau. It is there undulating and reaches to the snow-capped Tang-la Mountains, which border it on the south. The pass by which we crossed, and which is also used by the Mongol caravans, has an altitude of 5000 m., but as compared with the valley of the Mur-usu a relative altitude of only 630 m. Of the eastern part of the Tang-la we could learn nothing but what was confused and uncertain; nevertheless I think I may venture to say, that the range stretches as far east as the point where the Blue River turns abruptly south, and that in that range we must seek for the sources of the most important rivers of East Asia, namely the Jang-tse-kiang on the one side and the Mekong and the Salwen on the other. The part of the range which we saw reaches an altitude of at least 5700 to 6000 m. On the north side the snow-line reaches up to 5100 m. and on the south side perhaps to 5250 m. On both north and west the range possesses broad glaciers. The mountains are steep, though seldom rocky. The climate on the Tang-la plateau is exceedingly severe. Storms rage there all the year through. According to the natives vast quantities of rain, hail, and snow fall during the summer. The winter is very harsh: in the beginning of November the thermometer registered — 30° C. and in the middle of December — 31° C. at sunrise. Vegetation is of course poor. On the southern slopes there are some mineral springs. It took us eight days to get over the Tang-la, the climb, in consequence of the hardships and privations of all kinds that we endured, costing us four pack-animals. On the summit of the pass of Tang-la (5000 m.) we found a Buddhist obo.

The country which we then traversed is very monotonous. On the right we saw the snowy mountain Munkar and through the valley by which we were travelling flows the Tan-tschu, a tributary of the Nap-tschu (Chara-usu), and on the other side of it rise the Samtijn-kansijr Mountains. The climate was however milder and the sky bright. We sometimes met Tibetan nomads.

The mountain of Bumsa, which was to be our farthest point south in Tibet, has an altitude of 5200 m. In respect of both shape and formation it deviates from

the other mountains on the high plateau. Its eastern and southern slopes are very steep, and abound in mica and black gneiss. The summit is flattened and does not reach the snow-line. For Tibet, our camp was however favourable, for we had access to forage, argol, and spring-water.»

Then follows the account of the return journey, and after that we read, »At Tschu-nagma we left our old route and struck into a new one almost parallel with it. We crossed over the western part of the mountains of Tsagan-obo and then struck across the plain that stretches to the Dung-bure Mountains.

We had spent the end of December on the southern half of the Tibetan high plateau. Generally the cold was severe: twenty-six times we had a temperature of — 20° C. and six times — 30°, and our absolute minimum was — 33.5°. During the course of the month we had fourteen violent storms and nearly always a cloudy sky. We crossed over the Marco Polo Mountains by the pass of Angijr-daktschin, (4850 m.) situated immediately west of the Mountain of Balduin-dordschi (5400 to 5700 m.), which, like the massive of Sube, belongs to the Marco Polo system; this latter reaches a mean elevation of 4800 to 4950 m. Our Mongol declared that this chain extends a very great deal farther towards the west.

After crossing over the plain that lies north of the Marco Polo range, we came to the small, but very steep chain of Gurbu-najdschi (alt. of pass, 4380 m.). On the east it is connected with the Gurbu-gundsuga range, and on the west is united with the Marco Polo range by the massive of Schara-guj. North of the Gurbu-najdschi flows the Najdschin-gol, which has its springs on the snow-covered mountain-mass of Umijke, belonging to the Marco Polo system. This river separates the Toraj chain from the Gurbu-najdschi and the Gurbu-gundsuga, and then turns north, and finally empties into a small salt lake in Tsajdam not far west of the salt lake in which the Bajan-gol terminates. The bed of the river is narrow and clayey. At the point where it turns north the Nandschin-gol is joined by the Schuga-gol.»

Finally they crossed over the Toraj range by the pass of Koko-tom (3410 m.), and from there Prschevalskij returned home by way of the Koko-nor and Ala-schan.*

These brief extracts from Prschevalskij's First and Third Journeys will be sufficient to give us an idea of the general physical geography of the Tibetan highlands. As in the parts of Tibet which I visited and have described in the third and fourth volumes of this work, we find here again, in the regions east of those which I traversed, a great swelling and along it run several mountain-ranges parallel to one another and on the whole stretching from east to west. These start far in the interior of the internal drainage region of the Tibetan plateau, where they possess as a rule an insignificant relative altitude; and they stretch east and south-east towards the frontier of China proper, where they become more accentuated, their outlines being more deeply chiselled and more rugged, and their relative altitudes above the valleys between being greater. In the region explored by Prschevalskij they are in general flat and broad, with predominantly rounded forms, and are for the most

* Prschevalskij, *Is Sajsana tscheres Hami v Tibet i na Verschovja Scholtoj Reki. — Reisen in Tibet und am oberen Lauf des Gelben Flusses* (Jena, 1884).

part covered with detritus. Between them stretch the relatively level high plains or latitudinal valleys through which flow the head-streams of the Jang-tse-kiang.

The climatic characteristics which Prschevalskij notes agree also fairly well with the climate of the Tibetan plateau in general. It is particularly interesting to learn that real sand-storms and dust-storms are characteristic of the extreme east of Tibet. They are at all events far more general there than in the interior of the highlands; unless, as I have already hinted, it was due simply to the season of the year in which my journeys fell that I seldom or never experienced similar storms. Storms do occur indeed at all seasons of the year; but it is extremely seldom that they are charged with any appreciable quantities of dust or sand. The ground is for the most part so moist that even the very strongest wind is powerless to effect any transportation of it. It is to the transporting power of the water that I for the most part attribute the filling up of the self-contained drainage basins.

Leaving out of account the magnificent scientific collections which he brought home with him, Prschevalskij's chief importance lies in the fact that his journeys were pioneer efforts, by means of which he inaugurated a new era in Central Asian exploration. But in points of detail his geographical discoveries need, almost throughout, the most thorough revision. Rockhill says truly, »In the light of more recent investigations we are able to correct a number of errors into which this traveller fell.»

Simultaneously with my journey of 1891 and 1892 W. W. Rockhill was also able to shed fresh light upon the regions west of the great road by which the Mongol pilgrims travel to Lhasa, regions of which we had only the very slightest knowledge through the famous journey of Huc and Gabet and later through that of Prschevalskij. In point both of fulness and of topographical drawing, the map which Rockhill published after his journey is superior to most others dealing with Tibet.

CHAPTER XXVIII.

ROCKHILL'S JOURNEY ACROSS TIBET.

I will now proceed to quote certain passages from Rockhill's interesting journey which are illustrative of the general characteristics of high Tibet. The itinerary which falls within the scope of our observations is that from Tsajdam to Nag-ch'u (Naktschu). This is directly concerned to no slight extent with the self-contained drainage-regions of Central Tibet, and for a certain distance is in contact with the route which I followed towards Lhasa. I quote from Rockhill's diary for May, June, and July 1892. I make no change in his spelling of geographical names.

On the 17th May he started from the lower Naichi-gol and rode south towards the Talen-tak Mountains and the pass of Kano, which Prschevalskij calls Gono.

»The sand blown from the Ts'aidam by the prevailing winds is piled up on the foothills to a depth of several hundred feet.» The mountains west of the transverse glen by which the river breaks through is called Toré-ula, though Prschevalskij calls it Torai-ula.

May 18th. Crossing the Kano pass (12,190 feet), he again came down to the Naichi-gol, »the country [being] everywhere absolutely devoid of vegetation, only a mass of débris and sand. The river (some sixty to seventy-five feet wide and about three feet deep in the middle) flowed between high vertical banks.» Higher up they forded the river Schugu-gol, that flows down from the Schugan Mountains; it was almost as big as the main river. Beside the latter, in the district of Tsahan-tohé, good grass was found.

On the 19th May he continued on up the valley, crossing over the little secondary pass of Koko-tom-k'utul. The next day too he travelled up the valley of the Naichi-gol. »The Naichi-gol from Tsahan-tohé to Buhutu is very swift, with a drop of about 30 feet to the mile. Along the bank on either side are many large springs. It may be, however, that the river water (which is of a grayish colour) percolates through the loose gravelly soil to reappear beautifully clear in these spring-like pools, thence flowing back into the river.»

The following day he rode to Tator, still in the same river-valley, which is bordered on the south by the range of Amtun-ula; on the 22nd he reached Kuré-bori, and on the 27th Tabu-obo.

May 28th. »About eight miles above Tabu-obo we left the Naichi valley and rapidly ascended over the hills along the Sharakui-gol for about three and one-half miles . . . From our camp the Dzuha-ula bears north-west and the Umehé east-north-east, while the Sharakui-daban bears due south. Prschevalskij, on his map, has misplaced these mountains, putting the Umeké to the west of the Sharakui-uala (his Sharagui), whereas the latter is in reality contiguous to the former on the west. The Sharagui-gol is a clear mountain rivulet tumbling down over granite boulders from the snow-covered pass».

May 30th. By a very easy ascent of about eight miles we reached the top of the pass . . . The hills on either side of the pass are entirely covered with broken up granite and slate, like all high peaks in this region, and are bare of any vegetation. To the south we saw from the pass a broad undulating plain, running east and west with a pond here and there and bordered to the south by a low range of dark hills, the Koko-shili. We only descended about five hundred or six hundred feet over low hills of gravel and clay, on which not a blade of grass grew, but with here and there little moss-covered hummocks. After getting clear of the foot-hills surrounding the pass, we took a more westerly course over absolutely nude ground, cut occasionally by the dry bed of some torrent, till we reached a grassy slope on the first line of foot-hills leading up to a splendid snow-covered peak called Kuan-shong k'utur and which appears to me to be Prjevalskij's Mt. Kharza.

May 31st. We travelled to-day about eleven miles in a south-west direction over soft, gravelly soil, crossing six little streams of brackish water, the overflow of four pools a little to the right of our line of march. These streamlets flow into the Ch'u-mar. Although the country over which we travelled to-day seemed level, we descended about six hundred feet. We camped by a streamlet, near which we found a little grass. Our view to the west (or rather north-west by west) terminates at a huge snow-covered »massif», connected with the Kuan-shong k'utur by comparatively low hills. This great snow peak, for which I can learn no name, must be Prjevalsky's Shapka Monomakha or his M:t Jingri; this latter name I take to be his mode of transcribing *Gangri* or »snow peak». From where we have camped this snow peak appears to be distant some forty miles. To the south the Koko-shili-daban, over which the high road to Lhasa passes, trends east-south-east, and the western extremity of this range is, as well as I can make out, a little north of west, where it seems to sink to the level of the surrounding country.

June 1st. »About three miles south-west of our camp we came to the north branch of the Ch'u-mar, a miserable little streamlet, about six inches deep and ten feet wide, of dark red water. It flows here in a general east-south-east direction along the edge of a salt lake, about a mile wide and two miles long. The Ch'u-mar comes from the west-north-west.

June 2nd. »About five miles in a south-west direction, over gravelly soil, brought us to the southern and most important branch of the Ch'u-mar (Ch'umarin baron sala, or Namchutu ulan muren, Prjevalskij's Naptchitai-ulan muren), a rather rapid stream, about thirty feet broad and a foot and a half deep, flowing in several channels over a bed of soft sand at least a quarter of a mile wide. The river has a general east-north-east direction, its water is of the same dark red colour as that

Lith. A. B. Lagrelius & Westphal.

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of the north branch. Beyond the river the ground rises slightly, but remains of the same gravelly nature as to the north of it. After about six miles we came to the top of a sharp but short descent, at the foot of which were two lakelets and a few patches of grass. This is the Elesu-nor or »Sand lake», which has an outlet into another stream emptying into the Ch'u-mar.»

During this portion of Rockhill's journey, from which I have extracted above the most important geographical observations, he came into more or less intimate contact with the routes of several other travellers, *e. g.* Prschevalskij's and Krishna's, both of whom crossed the Marco Polo range by the Angir-takschia pass, while Rockhill crossed it by the pass of Sharakui-daban, situated somewhat farther west. Carey and Dalgleish, in the course of their short trip on the Tibetan highlands, crossed the same range twice, first by the same pass that I used between my Camps XXXIV and XXXV (1896) and the second time by the pass of Angir-takschia just mentioned. Thus Rockhill intersected Carey and Dalgleish's route immediately east of the lake which I only saw at a distance from Camp XXXIV (25th September 1896). With my Tibetan journey of 1896 Rockhill did not come into contact, or more correctly I did not intersect his route in Tibet. The points at which we approached each other nearest are my Camp XXXVIII at Mössuto and his camp of 28th May at Umeké-ula; the distance between the two is only a short day's march along the valley of the Naichi-gol (Nadschi-muren). The Marco Polo range forms the eastward continuation of the main crest of the Arka-tagh. The Bokalik-tagh is certainly only a parallel range north of the Arka-tagh. The lofty snowy mass which Rockhill saw bearing west-north-west from his camp of 31st May can hardly be the Schapka Monomakha, for this lies 170 miles from that camp. Rockhill's belief, that the Koko-schili comes to an end towards the west, admits of easy explanation: the range is very irregular and in some places very low, especially in that locality. Farther west it swells up again to a very big mountain-chain, for I had it south of my itinerary for two months in 1896. The vast latitudinal valley which I then followed, and which is broken up into a great number of self-contained basins, is continued eastwards by the open country which Rockhill crossed over diagonally during the last days that I have cited, the country which is traversed from west to east by the river Tschumar or Namtschutu-ulan muren. Rockhill's route was intersected immediately south of his camp of 1st June by Wellby and Malcolm. When I proceed to deal with the principal results of Wellby's journey, we shall have to speak again of the river Tschumar.

From the Tschumar and for a long distance to the south-west the only traveller who has journeyed there is Rockhill, and what he has to say about it is therefore of the greatest importance. His statements supplement also the observations which I made in the region immediately west of it. In his *Diary* for the 4th June Rockhill says: —

»A very gentle ascent of seven miles, the latter half over grass-covered hummocks, brought us to the foot of the Koko-shili-éken-k'utul, or »Upper-koko-schili-pass». A good-sized brook flows down from the pass, the hills rising not over eight hundred or nine hundred feet above the level of the Elesu-nor. The point at which we are crossing the Koko-schilis appears to be very near the western extre-

mity of the range . . . To our west these hills seem to be lost in a maze of low hillocks, forming the south-western limit of the Ch'u-mar basin.

June 5th. Two miles above our camp we reached the summit of the pass, the ascent all the way being absolutely without difficulty. The descent was even easier than the ascent; the hills to their summits were covered with grass . . . The whole range, from north to south, is not over ten miles wide . . . After crossing the range we took a due westerly course along the foothills, over a yielding reddish gravel, with an occasional snow-covered hummock and a few grassy hollows. We had now the great Dungburé range in view, about thirty miles to the southward, trending, as well as I could see, east-south-east and west-north-west. This range is an imposing one, with numerous high peaks, not a few covered with snow far down their dark, steep flanks. Between the Koko-shili and the Dungburé are several short spurs of no great height, of red sandstone apparently, and they are parallel to the main ranges; a number of little streams flow on either side of these, all emptying beyond our range of vision into the Nam-ch'utola-muren . . . We camped well up on the foothills at a spot where we found good water and plenty of grass . . . The Koko-shili are here not over three hundred feet high, but a few miles to our west they rise to perhaps six hundred feet.

June 7th. We continued over very soft gravel, in which our horses sank to their knees; it was as bad as quicksand; the incessant snowing and raining has turned these hillsides into shaking bogs. We crossed three little rivulets, meeting at the foot of the hills and flowing south-east around one of the short red sandstone ridges in the main valley and parallel to its axis. We then came to a rather dry spot, covered with fine grass and abundant water, where we camped (15,700 feet).

June 8th. An inch of snow fell during the night and this morning the ground was softer and more trying on the animals than ever. After a few miles in a westerly direction, we turned south-west, and after crossing some steep red sandstone hills and wading through heavy red sand for several miles we came to the north branch of the Namchutola-muren (or ulan-muren), here about fifteen feet broad and a foot deep . . .

June 9th. We continued in a southwest direction along the foot of a sandstone mésa, which here bounds the basin of the Namchutola, and camped in a hollow at its foot at a point where the valley takes a westerly bend . . . Daily wind and mud have greatly impeded our progress; for the last two or three days we have been obliged to lead our ponies, as it is impossible to ride through the deep, soft mud.

June 10th. We took a south-west by west direction and made for a high snow-covered peak, apparently the culminating point of the mountains to our right and left, and therefore christened by us Namchutola tolh'a or »The Head of the Namchutola». We followed the left bank of the middle branch of the Namchutola, crossing two good-sized affluents, which, though now nearly dry, flow in rock-strewn beds over a quarter of a mile in width. These feeders come from the adjacent hills and cannot be over six or eight miles long; hence one may conclude that at certain seasons of the year the rainfall here must be extraordinarily heavy. To the

south appear low ranges of red sandstone running east and west, and beyond these again rise the peaks of the Dungburé, in this part apparently of no great height. As we neared the base of the Namchutola tolh'a, the ground became hummocky and the grass fairly good, though short. We passed by several lakelets and finally made camp beside four small pools of sweet water fed by the melting snow on the summit of the mountain . . .

June 13th. About two inches of snow fell early this morning, the storm, as usual, coming from the west-south-west and preceded by an easterly breeze. I fancy there is a regular warm and moisture-laden current from the east, which, on meeting the cold, dry westerly currents prevailing in these regions, results in a hail storm or a sharp fall of snow, as in the present case . . .

June 14th. To-day we travelled some six miles in a south-west direction to the foot of a short red clay and sandstone range, trending east and west, and camped in a little gorge just as a violent hailstorm (stones half an inch in diameter), accompanied by very sharp thunder, swept down upon us. Height 15,900 feet . . .

June 15th. An inch and a half of wet snow covered the ground this morning, enough to prevent the mules and ponies from getting anything to eat. A little after daylight a violent squall of hail struck us, but by 9 A. M. the sun had nearly melted it all and we got off. We trudged up the bed of the stream — which flows from west to east along the base of the Ulan-ula, »Red Hills», as we called them, emptying somewhere into the Namchutola or one of its feeders — plunging all the way knee-deep in mud and water, till we reached its source and the west end of the Ulan-ula. From here we enjoyed a gorgeous view of a perfect maze of mountains, short ranges and little *massifs*, all trending in a general east and west direction. Some eight or ten miles to the west was a beautiful snow peak, seemingly the point where the mountains to our north and the Ulan-ula culminate. At its southern base was a lake, its greatest length being apparently from north-west to south-east. The lake we christened Trashi ts'o-nak . . . A rapid descent of about three miles brought us into a broad valley with a little stream flowing in an easterly direction in a very broad bed, to meet, beyond the east end of the Ulan-ula, the Namchutola. South of this broad (and dry, for a wonder), valley rises the main range of the Dungburé, or rather the western extremity of the range, or Dungburé eken, a mountain of dark colour and easily recognizable by that peculiarity, as all the other hills hereabouts are of reddish hue. The valley in which we have camped, though sandy, is tolerably well covered with grass.

June 16th. We continued our journey in a south-west direction by a very easy road up the course of a torrent (now nearly dry), which has its source on the west flank of the Dungburé eken, and then crossed a low col, from which we had a fine view of the Trashi ts'o-nak. Lake Trashi ts'o-nak, as seen from the pass, appeared some six or eight miles from east to west and perhaps two miles broad. To the west of it, some thirty miles or more away, I saw a fine snow peak. We then descended by a short and narrow gorge leading into another broad valley down which flows a small stream, a feeder of the Toktomai. We had entered the basin of the Murus, the Dréch'u, the Yang-tzŭ-kiang of the Chinese. I may here

remark that on none of the passes which we have crossed, and many of which were over 16,500 feet above sea-level, did we find old snow, so the snow-line in this region cannot be lower than 17,000 feet above the sea . . . From a little above our camp I had pointed out to me, due south of us, M:t Buha mangnä. Between this dark, truncated, pyramid-shaped peak and ourselves is a perfect sea of hills, all trending more or less east and west. Nowhere can I see a snow peak; they are extremely rare in this region; we have not seen a dozen so far on the journey . . .

June 17th. We descended to the foot of the hills to a little stream which flowed in a south-south-west direction, between low hills of fine bluish sandstone, and followed it for some twelve miles to where it took an easterly bend, to empty into some other feeder of the Toktomai. To the south of where we have encamped to-day is another plain running east and west, in which the red sandstone again crops out, forming a short range of hills, and from the top of a hill behind our camp I saw that this sandstone formation extends as far to the west as the eye could reach. Small ponds and lakelets dot the plain to the south of us, and others appear here and there to the westward. The country seems badly drained, here the waters empty into small sinks, there they flow off to feed the Toktomai.

June 18th. We crossed a plain about three miles broad, in which were several lakelets and also a small stream flowing in a south-west direction through a broad opening in a line of low, red sandstone hills. Passing this, we continued in a south-south-west direction over an open plateau, bordered to the south by a range of hills running nearly east and west, but so confused and cut up that it was difficult either to lay them down on the map or indicate their trend with any accuracy. At their northern base, some eight miles away, several rivulets which drain this broad plain meet to form the northernmost fork of the Toktomai-ulan-muren, »the gently flowing red river». Some thirty to forty miles to the west of our route and in the line of the axis of the little plain in which were the two lakelets noticed previously, I saw a fine snow peak. We made about fourteen miles and camped by the river bank, where fine grass covered all the country round. The Toktomai is at this spot about twenty feet broad and two feet deep in the middle, with a strong current. To-day has been the first since we left the Naichi valley, 23 days ago, in which we have had neither rain, snow, hail nor wind . . . The prevailing winds have become southerly, a quarter from which they never seem to blow in or near the Ts'aidam.

June 19th. We followed the river to-day fifteen miles, crossing it twice on the way, the valley broadening out a little below camp to nearly five miles in width, the bottom land of fine reddish gravel, boggy in many places, the higher ground covered with good grass. The river has a swift current with a pace of about twenty feet to the mile. The mountains on the west side of the valley are considerably higher than those on the east, which are not over two hundred feet high. Nearly due south of us is the Buha mangnä, along whose western flank our route lies, while the highroad to Nagch'uk'a runs some little distance from its eastern base.

June 20th. Eight miles below camp the north branch of the Toktomai is deflected due east, around a small hill with a rocky crest, and at its eastern ex-

tremity it empties into the southern or main branch of the Toktomai, which flows down a broad valley running due east and west, and some forty miles in length.

Leaving the north branch at the bend, we continued due south for six miles, till we came to the south branch, a good-sized river flowing in a number of channels over a soft sandstone gravel bed a half mile in width. We had not a little difficulty in getting across, as the channels were deep and the sand very soft. There is certainly five times as much water in this branch as in the northern. We camped near the river, and I saw far to the west, probably forty or fifty miles, a large, snow-covered mountain in or near which, I take it, the south branch of the Toktomai has its source . . . Nothing but a small plain now separates us from the Buha mangnä, which rises dark and imposing some ten miles to the south-east of us . . . The grazing is excellent on every side of us, and the weather continues fair . . .

From what I have been able to learn so far there are three roads leading into Tibet from the north, and all probably parallel to the trail we are following: 1st. By the highroad via the Angir-takshia; 2nd. West of the one we are following, and followed by the Taichinär Mongols of Hajir, leading over country similar to that we have traversed, crossing no high passes, but along it water and grazing are poor; 3rd. Considerably farther west than No. 2 and leading directly from the Lob-nor. This last is followed by the Torgot Mongols and is, I imagine, the one taken by Bonvalot. It is said to be very bad.

I caught a glimpse of the famous Dang la chain this evening; it is the first really imposing range I have seen . . .

June 21st. A few miles south of our camp we crossed some very low hills which prolong the foothills of the Buha mangnä to the west, and entered the basin of the Murus. From this point we got our first view, in a south-east direction, of an immense snow-peak, probably Prjevalsky's Mt. Dorsi, but called by my guide Atak Habseré mengku. Crossing a rivulet, which probably empties into the Murus about twelve miles east of our route, we ascended another range of low hills and the Murus (»The River») was before us. Crossing the col we camped about a mile below it; the river about a mile farther south.

Climbing a steep hill directly east of our camp I had a splendid view of the great Dang la range, certainly the most imposing chain of mountains I have seen in Asia. While its eastern extension was far beyond our line of vision, its western end did not appear to be over forty miles away . . .

June 22nd. We followed up the course of the Murus for about nine miles over sandy soil tolerably well covered with grass. The river bottom where we came on to it is about six miles wide. To the south it is bordered by a range of very low hills, beyond which is another low range running parallel to the main or Dang la chain. In this latter valley is said to flow the southern branch of the Upper Murus, or rather the principal feeder of the headwaters of this river. The water reached to the horse's back and the current proved very strong, but the river bottom was hard. The water was very muddy and the river much swollen from the melting snows and by the daily rains, but there was no evidence that it ever overflows its bed to any considerable extent.

June 23rd. It rained heavily during the night and this morning it was very cloudy. We followed up the river in a south-west direction for about ten miles, then crossing it where it flows due south and north, we continued in a westerly direction about two miles and camped near some pools of water at the foot of a line of low hills. Where we crossed the Murus to-day it was about two feet deep and probably seventy-five feet wide. This does not necessarily imply that we are far from the sources of this great river, as in this region a stream grows with wonderful rapidity. I traced up with my eye the course of the river for about ten miles, and could see numerous brooks emptying into it, quite enough to account for its volume where we crossed it. The Murus' ultimate source is certainly in the snows and ice on the Éken Habseré, which is very nearly south-west by south from our camp of this evening. A curious feature of the valleys of the Murus and of the Toktomai is the presence there of innumerable little pools or sinks, in which is collected all the water that falls in the valley bottoms and over a large area of the contiguous hills. These pools have no visible outlets into the rivers. To-day, for example, we certainly passed twenty-five such lakelets, some of them on the very bank of the stream.

June 24th. We made fourteen miles in a west-south-west by west direction up the valley of the Murus which we entered yesterday after crossing that river. There was a steady though hardly perceptible rise in the ground. The usual 2 p. m. thunderstorm visited us again to-day, and as usual also it came from the west. Since leaving the Ts'aidam we have never had a storm from another quarter.

June 25th. We are camping to-night at the head of the Murus valley in this direction, and at an altitude of 16,850 feet above sea-level. We have also reached the west end of the Dang la range. The country all the way here was of gravel, and for a few miles before making camp the ground was covered with grass-grown hummocks. The hills on either side of us are three hundred or four hundred feet high, but the main range to the north, which bends now in a slightly northerly direction, and is some five or six miles away, rises over two thousand feet above the surrounding country.

June 26th. We crossed the foothills of the Dang la, taking a west-south-west by west direction. In the first place, we passed six or eight miles south of a small lake, possibly three miles long, and which we called Dzurken ula nor . . . To our west, some twenty miles away, rose a short range of mountains with its central portion covered with snow . . . We have left the valley of the Murus behind; the water from all the surrounding hills south and west of us empties into the Dzurken ula nor. We are at last on the central plateau of North Tibet. From its flanks flow the Murus, the Salwen and half a dozen other great rivers, and here is also the eastern extremity of the great Central Asian Plateau. Away to the southwest there is a low ridge running westward and connecting the Dang la with another range of hills, but we have, as we hope, turned the great mountains. The snow peaks at whose base we are now camped are truly the »Head of the Dang la» (Dang la tolh'a). They rise apparently 2000 feet above the snow-line and as at least for 1000 feet above where we are camped (17,000 feet above sea-level) they are without snow, we must conclude that the line of perpetual snow in this region is at very nearly 18,000 feet above the level of the sea.

June 27th. We continued to-day in the same west-south-west direction as yesterday, along the foothills of the Dang la, crossing a number of torrents, one about two feet deep and thirty to forty feet wide, but flowing in a bed at least one-third of a mile in width. The soil is everywhere fine gravel and very little grass grows anywhere on it. Our view of the Dang la and its snow-fields is absolutely unobstructed. I cannot decide whether there are any glaciers; I am inclined to think there are none. The rocks I see are all limestone and granite. The whole country, as far as I can see, is covered with hills, between which are pools and lakelets receiving all the drainage.

June 28th. A couple of miles from camp we crossed a low col, and then took a south-west course over a perfectly bare plain of gravel, cut here and there by torrents, some with beds over half a mile wide, which empty into a stream flowing westward and which we called, on account of the great quantity of ice on its surface, Kétén gol or »Cold River». We are now well to the west of the Dang la, which stretches out in a south-east by south direction, as far as we can see. Some twenty miles south of us we can distinguish a short range of black hills, and nearer to us in the same quarter another short range, running south-east and north-west, from which issue several streams emptying a mile below our camp into the Kétén gol. No mountain-range of any importance beside the Dang la can be seen, but innumerable little blocks of hills intersect the country in every direction. The soil is very barren; where we have camped there is a little grass, but elsewhere there is only sand and gravel. The soft wet gravel, through which we have of late travelled so much, has been very trying on the feet of our ponies and mules; every one of them is lame.

June 30th. The hills to the west-south-west of our camp, and over the southern extremity of which we had to pass, are composed largely of flints. From their summit we caught our first glimpse of a large expanse of dark blue water about twelve miles to the south-west, and on whose western shore rises a steep and bare red sandstone hill. We crossed the Kétén gol at its mouth on the shore of the lake, and camped on a green hill-slope one hundred feet above the water. The lake is about fifteen miles in its greatest length (north-east to south-west) and in places seven or eight miles wide. The water of the lake is nearly undrinkable, and possibly there are deposits of pure salt near here. The grazing is splendid.

July 1st. Our route lay parallel to the shore of the lake over a slightly undulating country. About three miles south of our camp we crossed a good-sized though shallow river, which comes from out the hills to the south-east, some ten to fifteen miles away. Farther on we crossed the dry beds of several torrents; they were nearly a mile in width in many places. We camped about nineteen miles south-west of our camp of yesterday, on the bank of another small stream flowing into the lake from the hills which surround it on the south. The water of this stream like that of all those emptying into this lake, is very brackish, nearly unfit for use. I was unable to detect any outlet for the waters of the lake, though it seems hardly credible that evaporation can dispose of the enormous quantity which must flow into it, and I have seen no signs of its level ever being much higher than at present . . . The grazing is now good everywhere and our animals are doing well.

July 2nd. We took a south-south-west course parallel to a short range of mountains of no great height on our right. The sandy plain over which we travelled is traversed by a number of small streams flowing, some westward, into a lake at some distance to the west, the others emptying into little pools at the foot of the hills. From the low red sandstone hill on which we have camped, I can see that the hills to the south of Chib chang ts'o (the lake of Kétén gol) run west as far as the eye can reach.

July 3rd. We travelled to-day about twenty miles for the greater part of the time in a nearly due southerly direction; crossing two ranges of hills projecting from those to our east, and running due east and west; the stream between them flowed westward. These hills appeared to be composed mostly of shale of a yellowish colour. The ground under our feet was of fine gravel, and very little grass was anywhere to be seen. Two miles before making camp we crossed a col, the ascent to which was quite long; I made it out to be 16,500 feet above sea-level. From where we have stopped, a couple of hundred feet below the summit on the south side of the pass, we command an extensive view, but I can see nothing before us but mountains and jagged walls of rock projecting from their summits.

July 4th. During the night it rained hard from ten to eleven o'clock, and then for three hours it sleeted. The storm, which was accompanied by thunder and lightning, came as usual from the west. After crossing a little stream flowing westward, we entered to-day a broad valley. At its southern end the stream flowing through it bends abruptly westward and enters a narrow gorge. The upper part of this valley is marked by a curious ridge of rocks, probably limestone, running east and west, and which, from a distance, might be taken for a line of old gnarled and dead trees, so sharp are their outlines. In this valley we came again on the high-road followed by those going to the northern salt mines, and we had to make up our minds to follow it, for no other route led out of the valley. We had to camp near a lakelet on the top of the pass at the south end of the valley . . .

July 5th. The summit of the pass turned out to be about three miles beyond our camp (16,000 feet), but only a few hundred feet higher than it. We rode to-day in a south-south-easterly direction over hills and across dales all trending nearly due east and west, all the water flowing westward and emptying into a large lake some six or eight miles to the west of our route. We also saw from one of the cols we crossed, and some fifteen miles east of it, a large sheet of water . . . After about twenty-two miles over a fairly easy trail we came to the mouth of a little valley, whence we could see, some twenty-five miles to the south, a range of dark hills running east and west, but nowhere any signs of human habitations.

July 6th. Our route lay south-south-east over a gently undulating plain, the streams which crossed it running south-west by west to empty into the big lake we saw yesterday. This lake is called the Yirna ts'o, and is a soda lake. At 2 p. m. we came to a river flowing westward in a broad flat bed of mud and sand. The name of this river is Tsacha tsang-bo ch'u. On some European maps it is figured (but too far north) as the Zacha Sangpo or Yargui tsumbu. The latter name looks as if it might be intended as a transcription of Jirna tsang-po, »the river of the Yirna (ts'o)». We had great trouble in getting across. The water flowed

rapidly in a number of channels, and it took us two hours to lead the horses across, a man walking on either side of each pack-animal holding up the load. Several fell in the stream, or sunk in the quicksands and had to be unloaded in the river. Just as we made camp, about a mile south of the last channel of the river a violent storm of hail and rain swept down and drenched every article of clothing which we had so far kept dry.

July 7th. It had rained again in the night. We rode in a southerly direction towards a col we could see in the range of hills before us. We kept on towards the hills and camped near some pools of water at the mouth of a valley and about a mile away from some small black tents, around which flocks of sheep were grazing.

July 8th. We pushed on up the valley and soon reached the top of the range. On its southern side was another broad valley ten or twelve miles in length and three from north to south, and beyond was yet another range of hills. To our left some six miles away, appeared a lake, probably two or three miles from north to south and eight miles from east to west; this I was told later in the day was the Namru ts'o. In the valley before us were six or eight tents, each with a little flock of sheep and some yaks grazing round it. We stopped near one about two miles below the summit to ask the road, and found that there were Lh'asa traders in it.» . . .

At this point Rockhill was stopped and prevented from carrying out his purpose of trying to penetrate further in the direction of Lhasa. I may now add one or two extracts dealing with the stretch of country between Namru-tso and the road from Si-ning to Lhasa.

»July 14th. We crossed the river this morning during a violent thunderstorm, at the ford used by the Namru; the Tsacha flows here in two branches, and the water is about four feet deep. We turned our faces northward and struck out over an undulating plain on which was here and there a pool of brackish water, and after a short ride camped at the foot of the hills, by the river bank, at a point where the river, which comes from the east-north-east, takes a bend southward.

July 15th. We rode all day upon the right bank of the Tsacha ch'u in an east-north-easterly direction, crossing occasionally some little affluent coming down from the hills. Though we passed many old camps, we only saw one tent and that on the left bank of the river and in the Amdo ts'o-nak district . . . We camped for the night on a muddy and marshy plain near a good-sized river which, coming from the west, empties into the Tsacha tsangbo ch'u a few miles to the east of us . . . The constant heavy rains at this season of the year make travelling in these parts slow, wearisome, and difficult, for, to add to the fatigues of the journey, fuel is very scarce, as nearly all is soaked by the rain. The soil is everywhere gravel and clay, and one sinks into it knee deep. Riding is out of the question, the horses have as much as they can do to pull themselves through the mud . . .

July 16th. Crossing the stream near which we had camped, we followed up the course of the Tsacha tsangbo through a broad grass-covered valley. It would be more correct to say that we followed up the course of the northern branch of the Tsacha, for a few miles east-south-east of our camp of last night a stream,

quite as large as the Tsacha itself, and which comes from the east, empties into it . . . From where we have camped we can see to the north a snow-covered range, the Dang la, I suppose. The nearer one gets to this great chain the worse the weather becomes. These mountains arrest the moisture-laden clouds coming from the south-east, hence the deluge of rain and the boggy state of this whole region during half the year. The Dang la and its continuation to the east mark the farthest point north to which the monsoons reach.

July 17th. The last branch of the Tsacha was forded a few miles beyond camp, and after crossing a low range of soft, gravelly hills, we entered the basin of the Chang t'ang ch'u, which, coming from out the mountains to the north at a point far to the east of us, flows south as far as we could make out its course. Two large streams and a number of streamlets empty into it a little to the south of our line of march. The soil was everywhere boggy, the horses sunk into the soft gravel at every step, and we had to lead them most of the way . . . The whole country through which we have travelled to-day is but a succession of pools and streams. I never saw such a soaked and reeking region in my life.

July 18th. The storm of last night has turned the already muddy soil into a quagmire, and it took us all day to make about eight miles over a range of low hills and to ford the Chang t'ang river. At every step we took we sunk in the mud (a mixture of gravel and clay) up to our knees, and it was pitiable to see the poor mules tumbling down every few steps, unable to pull their tired legs out of the mire. Strange as it may appear, the muddiest spots in this region are always to be found on the hillsides, all of which are of gravel. About eight inches below the surface is water, which, for some reason I have not as yet worked out, but probably on account of a hard substratum of clay, does not drain off. Along the river-bottoms there is comparatively little mud; the ground there is sandy and firm.»*

After following for a few days longer the southern foot of the Tang-la, Rockhill on 21st July approached the road between Lhasa and Si-ning. My object in making these extensive extracts is to supplement my own account of eastern Tibet.

* W. W. Rockhill, *Diary of a Journey through Mongolia and Tibet in 1891 and 1892*, pp. 181—250.

CHAPTER XXIX.

COMMENTS ON THESE JOURNEYS. A—K—'S JOURNEY.

Rockhill has thus described the country that he travelled through in brief, but striking, words, and given us a very clear idea of its general geographical characteristics. He had an opportunity to explore the transitional country between the self-contained drainage region of inner Tibet and the peripheral region which drains to the ocean; whereas I only grazed, as it were, the self-contained drainage region of eastern Tibet. The first salt lake that Rockhill touched was the Dzurken-ula-nor, and subsequently he noticed the broad, shallow channels in soft ground by which the internal drainage waters make their way into the salt lakes. In the case of the Koko-schili, Dung-bure, and Tang-la Rockhill believed that he had reached the western extremity of each range, or at any rate that they severally terminated not very far west of his route. He supposes therefore, that these chains, running from west-north-west to east-south-east, are characteristic of the border regions of eastern Tibet, and that they are backed on the west by a highland country, in which plateau characteristics predominate. In the meantime he may be in so far right, that the ranges in question do in general increase in relative height towards the east, where the latitudinal valleys have been more deeply excavated, and where the disintegration material and sedimentary matter are carried by the streams down to lower regions; whereas in the west, on the plateau, the latitudinal valleys are being increasingly filled up with the material washed down off the flanks of the mountain-ranges between them. The reason of his thinking that he had reached the western ends of these ranges was therefore his having crossed over them in parts where they happen to be of low elevation. Other journeys through Tibet prove that they do continue towards the west and west-north-west through practically the whole of Tibet. This is peculiarly true of the Marco Polo range, which is only an eastward continuation of the gigantic Arka-tagh. And this too is the case with the Koko-schili, a system which for a distance of close upon ten degrees of longitude separates the latitudinal ranges in which I and Wellby travelled, and it was no doubt the westward continuation of the Dung-bure range which Wellby had on the immediate south of his route. And as for the Tang-la, I assume that the big range which I crossed over north of our headquarters camp

(Camp XLIV) cannot have been anything else except the westward prolongation of this range, and that it continues farther towards the west-north-west, where we find it again in the immense swellings crossed over by Littledale and Dutreuil de Rhins. Later on I shall prove that it is an error to represent the interior of Tibet as a flat plateau country; on the contrary, that greatest upswelling on the earth is traversed by a countless number of mountain-ranges running parallel to one another, and situated between the Kwen-lun and the Himalaya. They form in fact a gigantic system of folded chains, in respect of their orientation recalling forcibly the Iranian folded system, the chains of which are likewise heaped up closest together in the west, whereas they spread out eastwards like a broom.

The regular parallelism of the ranges is quite as evident along the routes which Prschevalskij and Rockhill took in eastern Tibet as it is in those parts of the interior of Tibet which I and other travellers have journeyed through. The mountain-chains which reflect the vast folds into which the earth's crust has there been crumpled dictate the course which the principal rivers assume in the latitudinal valleys, as also the shape of the lakes, these being elongated from east to west. Along Rockhill's route however the Tschib-tschang-tso forms an exception to the rule, for its longer axis runs from north-east to south-west. What both Rockhill and Prschevalskij designated by the word »plain» is in most cases nothing but the broad, level latitudinal valleys, which however are frequently divided into several sections by minor chains running down their middle.

My itinerary from our headquarters Camp XLIV towards Lhasa appears to coincide in part with, or anyhow to be quite close to, some of Rockhill's stages, counting from the 4th July, and the point where he forded the Satschu-tsangpo on 6th July cannot be very far distant from the spot where I also forded it a month later, on the 1st August. From his description the river would appear to be far smaller in the beginning of July than in the beginning of August; still even then it was so large that the crossing occasioned great difficulty. Nevertheless these conditions will of course vary from year to year; two observations are not sufficient to warrant us in saying, that as a general rule the rainfall in August is heavier than in July.

Rockhill is in error in making the Satschu-tsangpo empty into the problematical lake of Jirna-tso, instead of into the Selling-tso, which lies at least 100 km. farther south-west. This fact was first shown by Dutreuil de Rhins, and I am now able to confirm the correctness of his observation, as Littledale had already done. The following note in Rockhill deserves quotation, although he is dealing with several little-known values, especially when we bear in mind the insufficiency of Bower's map.

»From Capt. Bower's map we learn that this important river has its source in about lat. 32° 45′, long. E. 90°, at an altitude of about 16,000 feet. Where I left this river, not over thirty-five miles from its source, its altitude was approximately 15,400 feet above sea-level. It certainly does not flow as far south-east as Capt. Bower's map shows, and the snow peak, around the east side of which it is there made to flow, is quite a distance south of the river.»*

* *Op. cit.*, p. 245.

In addition to his own itinerary Rockhill mentions three other routes through eastern Tibet leading to Lhasa. By the »Sining-fu high road» we are no doubt to understand the road which is generally used by pilgrims from Mongolia and by the Chinese authorities and the Chinese post travelling to and from Peking. But we may also just as certainly speak of a regular »faggot» of roads, which converge upon Lhasa from different parts of Tsajdam and Koko-nor, most of them merging into a common highway north of the Tang-la. It is in that region that we find the itineraries of Prschevalskij's first and third journeys, Huc and Gabet's journey of 1845, and the route of the Chino-Mongolian mission from Urga to Lhasa in 1873. Rockhill's itinerary lies almost entirely to the west of these. The road which he mentions as running from Lop-nor due south to Lhasa is pretty certainly not in use at the present time; for by making the little deviation through Tsajdam the caravan animals are spared.

Where the mountains, rivers, and lakes do not possess traditional names, Rockhill has hit upon the original and fairly happy idea of giving them native names of an illustrative and characteristic meaning, names as simple and as significant as the traditional names in use amongst the natives.

From Rockhill's description it is evident that grazing is far more abundant in the parts of Tibet through which he travelled than in those which Bonvalot, de Rhins, Littledale, and I explored. It may indeed be laid down as a general rule, that the vegetation grows poorer and scantier from east to west, though this does not hold good throughout Tibet. It is worst on the most central and highest plateaus, but grows more abundantly towards the west; indeed in the high valleys and glens that drain to the Jarkent-darja it is in many localities very good.

What Rockhill says about the climate is very interesting. He speaks of copious downpours and, especially in the southern part of his journey, of plentiful rains. Evidently the part of Tibet which he visited is more plentifully watered than the region to the west of it, as indeed might be expected from its geographical position and from the configuration of the country in relation to the monsoons; moreover it is suggested by the circumstance that the big Indo-Chinese rivers have their sources in that part of the country. Thus the amount of precipitation decreases from east to west and from south to north. Rockhill's observations however afford us confirmation of the existence of a distinctive rainy season, coinciding with the summer months. He found too that most of the watercourses and rivulets contained running water, although he also passed some that were for the time being empty. With regard to the Mur-usu, which he crossed over on the 22nd June, Rockhill says, there were no signs of the river having reached a higher level; this seems to indicate that he saw the river at the time when it was as a fact at its maximum. Neither at the Tschib-tschang-tso or any other lake did he observe any old strand-terraces. This is in some respects surprising, for it is otherwise the rule to find indications of that nature beside all the Tibetan salt-lakes. Generally it may be said that the desiccation of the lakes is increasingly more pronounced in proportion as you advance towards the west; but future and more searching investigations must determine whether the climatic retrogression from moisture to aridity is indeed more pronounced in the west than in the east. From what we

know, this would appear to be the case. Rockhill saw at close quarters only a very few of the internal drainage lakes, namely Tra-schi-tso-nak, Dzurken-ula-nor, Tschibtschang-tso, and Namru-tso, and his observations are too few in number to warrant the formulation of any general laws.

In so far as the wind is concerned, during the three summer months, and in the country that Rockhill travelled through, it was the same that appears to prevail everywhere at all times in Tibet, namely from the west. Almost every day he notes a westerly storm breaking out about 2 or 3 p.m. In respect of this phenomenon we do possess sufficient material to justify us in laying down the general rule, that all the year through and throughout the whole of Tibet westerly winds prevail.

Finally, we may notice, that Rockhill made the same observation which I did, namely that boggy ground, soft, marshy, swampy, is very common in high Tibet, this being one of the characteristic features of the country, particularly during the rainy season, and it is this which makes caravan travelling in a high degree so difficult. It was especially near the southern foot of the Tang-la that Rockhill experienced the worst difficulties from this cause, and this he ascribed, and rightly so, to the circumstance that the Tang-la mountains arrest a larger measure of the atmospheric moisture than the surrounding regions do, and it is this moisture which, sinking into the ground, renders it wet and miry like a dirty sponge. His experience agreed with mine, that the slopes of the flat hills, built up of loose materials, are generally more boggy than the bottoms of the valleys. The reason of this may be that in the latter the fine detritus is relatively more tightly packed, and has no opportunity to start the slow gliding movement which is discernible on the sides of the hills.

About the same time that the first, second, and third journeys of Prschevalskij awakened the admiration and liveliest interest of the whole civilized world, a series of geographical explorations were carried out in a very unostentatious way by certain Indian pundits, the results of which were at least equally as important as those of the Russian general. In the spring of 1878 General Walker sent the pundit A—K — (Krishna), well equipped with all sorts of scientific instruments, into Tibet, commissioning him to start from Lhasa and cross »the great plateau of Tibet into Mongolia» by the route that he should find most convenient, and then to return to India by some other Tibetan route. The pundit approached Lhasa *via* Tschumbi and Phari-dschong, and did not leave it until the following year, that is to say on 17th September 1879, when he travelled north in company with a caravan of Mongols and Tibetans. Sixty miles from Lhasa they crossed over the pass of Lani-la (15,750 feet), and then found themselves on the »highly elevated plateau which occupies the greater portion of Tibet, and is called the Jang- or Changtang, which literally means the Northern Plain; on entering it, the Pundit found that he had passed from a cultivated into a pastoral region, and from fixed habitations to wandering encampments.»

»A week's march carried the Pundit over ninety miles of the Chang-tang to the notable monastery of Shiabden. Up to this place and for about as far again onwards, the route lay through numerous encampments of Tibetan nomads, who dwell in tents covered with the black hair of the yak. The Pundit estimates the number of tents which he passed in this region as about 7000. But for the remaining 240 miles the Chang-tang was entirely uninhabited. The heights of his camping-grounds on the Chang-tang ranged from 13,500 to 15,000 feet; the highest pass crossed was 16,400 feet, on the Dángla range, which constitutes the water-parting between the upper basins of the Yang-tsze-kiang and the Mekong river. The route crossed the upper sources of the latter river — here called the Chiamdo Chu — as small streams taking their rise in adjacent hills to the west; it also crossed three of the principal affluents of the former river, the Maurus, the Ulángmiris, and the Ma-chu, each in itself a considerable river, and only fordable where split up into several channels; their sources lie in the lacustrine region to the west, probably far away; but at a short distance to the east they join together and form the river which Tibetans call the Dichu, and Chinese call the Kin-sha-kiang, and which eventually becomes Gill's River of Golden Sand, the Yang-tsze-kiang.«

»After a march of five weeks at this great elevation, the travellers reached a range called the Angirtákshia by the people of the country; it is the northern boundary of the Chang-tang, and is believed to be a continuation of the well-known Kwen-lun range of western Tibet. Crossing it by a pass of precisely the same height as the Lani-la, by which they entered the Chang-tang, they descended into the plains of Chaidam (Tsajdam), and in a few days found themselves down at a level of 9000 feet in a comparatively warm region.«

From the embouchure of the Naidschin-gol into Tsajdam A—K. — travelled the same way that I subsequently did across the Tengeliguin-gol to the Kurlik-nor, and thence north-west *viâ* Särtäng to Sa-tscheo. After making a prolonged stay in that city, he left it again in August 1881 and returned the same way to the Kurlik-nor. In the region of Dsun-sasak he came into contact with Prschevalskij's route of 1872: »Thence they proceeded to the Angirtákshia or Kwen-lun range, which they crossed at the Namohan Pass, about 180 miles to the east of their previous point of crossing. They now found themselves again on the Chang-tang plateau, but in a quarter where it is very much narrower than on their first route line, only 140 miles broad instead of over 400; they crossed another Ma Chu or Red River, one of the principal sources of the great Hoang-ho, and a range of hills called Lama-thologa.« After eight days of marching they approached Niamcho and after another five days Thuden-gomba. Thence it was not far to Thom-budha, the village at which Dutreuil de Rhins was afterwards murdered, nor to Kegudo, likewise known from the latter traveller's journey. From that place the Pundit travelled south-east to Darchendo or Ta-chien-lu. From there to Batang he journeyed by the same route that Captain Gill did in 1877. And then, after making a long detour to the south, he returned to Lhasa, thus gaining an opportunity to confirm the identification of the Tsangpo with the Brahmaputra, not with the Irawadi. This part of Krishna's wonderful journey lies however outside the limits of our investigation; for it belongs to the peripheral region *par préférence*, a region the main features of which alone

are partially known at the present time. Krishna's journey marks an epoch in our knowledge of Tibet, and in respect of purely geographical discoveries he surpassed the contemporary European explorers — Prschevalskij, Gill, and Széchenyi. His observations have also confirmed the correctness of several of Huc's statements, which before that had been somewhat doubted; Prschevalskij in particular, after his first journey, criticised Huc sharply.

From a native possessed of no greater general culture than that which Krishna commanded a detailed account of his journey on the European model was not to be expected. His task was simply to work like a machine or a self-registering instrument, and that task he executed in an ideally perfect way. Along that part of his route which directly interests us, namely the section between Lhasa and Tsajdam, he linked the topography together by astronomical observations, and also determined the altitudes above sea-level by means of boiling-point thermometers. He crossed the three large rivers which we know from Prschevalskij's third journey, and from Rockhill's route, his own itinerary running between these two. He calls the Murus (Mur-usu) the Maurus, Thoktho, or Di-Chu, and the Toktomai-ulan-muren becomes with him the Ulangmiris or Chu Mar; but he calls the Tschu-mar or Namtschutu-ulan-muren, correctly, the Chu Mar or Ma Chu.

The Pundit's original map was prepared for publication by Hennessey, and on it the parallelism of the mountain ranges with an east and west strike is very distinctly shown. But Hennessey has committed the error of inserting at 91° and 92° E. long. a meridional range, from which all the southern parallel ranges are shown as east-going spurs, while the Tang-la appears to intersect this range at right angles. Yet, considering the defective knowledge which then existed with regard to the structure of the Tibetan highlands, this conception was very plausible and natural. The Pundit had forded a number of rivers flowing towards the east, and what could be more probable than that they had their sources on the same common meridional range, a gigantic water-divide between these rivers and the unknown Tibetan highlands to the west. In what precedes I have already dwelt upon the existence of a similar boundary wall, so extraordinarily important from the physical geographical point of view, although it possesses in reality very different dimensions and a quite other geographical position than those which Hennessey supposed; for it actually reveals itself as for the most part a series of flat transverse thresholds or sills in the broad latitudinal valleys that lie between the parallel mountain-ranges.

It will be interesting to call to mind what General Walker says about the knowledge that was possessed of the lofty Tibetan swelling in the year 1884: »Notices of the western portion of this region have appeared in former communications to the Geographical Society, notably in the admirable paper on the Physical Geography of western Tibet by Captain Henry Strachey; but as yet the fact of its enormous extent, as well as great elevation, does not appear to have been fully recognised. It is a vast expanse of softly undulating plains, diversified with lakes and rivers and hill ranges and, occasionally, great mountains. In this region the hills spring from a level which is not much less on an average than 15,000 feet or little below the highest mountain in Europe. Though highly elevated, it is not

what would be called a mountainous region, for the hill ranges are usually far apart, and not 1,500 feet above the surrounding plains, and are well below the limits of perpetual snow in Tibet; occasionally, however, mountains are met with rising 5,000 to 10,000 feet above the plains, or 20,000 to 25,000 above the sea-level, and these are covered with snow all the year round. In many parts the passing traveller sees nothing but plains around him up to the sky-line. The plains are coated with a short succulent grass, forming from May to August the softest of green carpets, and furnishing an abundance of pasture for the flocks and herds of the Tibetan nomads, and also for myriads of wild animals which roam over the entire region, but mostly congregate in the uninhabited northern portion.»

Walker emphasises the fact, that the highlands of Pamir are closely connected with the highlands of Tibet, and he concludes his observations in the following words: »Thus the entire region of elevation stretches over some 30° of longitude, say 1,700 miles; its average breadth is about 300 miles, its average height probably exceeds 14,000 feet, and its area is about half-a-million square miles; it gives birth to the upper sources of most of the great rivers of Asia — the Oxus, the Indus, the Sutlej, the Ganges, the Brahmaputra, the Salwin, the Mekong, the Yang-tsze-kiang, and the Hoang-ho; and it constitutes the greatest protuberance that is known to exist on any part of the earth's surface.»*

In the course of the discussion which followed the reading of the paper by General Walker, from which I have just quoted, before the Royal Geographical Society, men so well versed in the geography of Asia as Sir Henry Rawlinson and Colonel Yule were lavish in their praises as to the value and significance of A—K—'s journey. *Petermann's Mitteilungen* likewise speaks highly of it, saying that, although A—K—'s determinations of altitude vary in several localities a good deal from those of Prschevalskij, Gill, and others, yet everywhere they confirm the impression which these explorers convey as to the regions traversed, and this applies especially to the plateau-land of northern Tibet, with the relatively insignificant parallel ranges of the Kwen-lun system.** On the other hand Prschevalskij criticises the Pundit's map rather severely, saying, »It is impossible to pass over in silence certain peculiarities of this map. It is published by the »Trigonometrical Branch, Survey of India,» and embodies the results of the Pundit's famous journey in 1879 — 82, together with numerous adjacent regions, and includes also the itineraries of other travellers. A considerable part of A—K—'s journey, namely from the spring of Niertschungu (on the other side of Tan-la), over the Tengelik in Tsajdam to the oasis of Sa-tscheo and from the lake of Toso-nor to the environs of the residence of Dsun-sasak, coincides principally with my own journey. The second improved edition of the map came out about a year after the publication of my *Third Journey*, and to it two maps were added, one showing the mountainous country of northern Tibet. If you compare that map with the map of the Pundit's itinerary, you will see that they are very different; whereas on the improved edition of his

* *Four Years' Journeyings through Great Tibet, by one of the Trans-Himalayan Explorers of the Survey of India.* By General J. T. Walker, in *Proceedings of the Royal Geogr. Soc.*, vol. VII (1885), pp. 65 ff.

** *Peterm. Mitteil.*, XXXI (1885), p. 6.

map his geographical coordinates exhibit an extraordinary agreement with those on my map. This is all the stranger because A—K— did not determine the geographical latitudes, and these could only be calculated from his previous map. One could almost believe, that the itinerary in question represents an eastward transposition, to the extent of 2 to 3 minutes, of the localities the position of which I determined. But under the map we read the following note: »Colonel Prschevalskij's itinerary is taken from the map which was published in *Petermann's Mitteilungen* in July 1883!» Now, seeing that the map in *Petermann* takes in the whole of my third journey, it ought to be added that the British cartographers ignore it and have not incorporated it on their map.»

Then, after some further remarks about the unreliability of the Pundit's topographical determinations, he goes on to say, »From the residence of Barun-sasak in the south-east of Tsajdam I travelled in 1884 by the sources of the Yellow River to Dij-tschu (Jang-tse). The Pundit traversed the same route nearly three years before I did and his mapping of it is very inaccurate, as will be seen from a simple comparison of the details on the English map with the map of my fourth journey. The following important errors at once arrest attention: (1) the existence of only one lake at the sources of the Hwang-ho instead of two, as we find on the Chinese maps; (2) the geographical position of the lake is incorrectly given; (3) Odon-tala is erroneously represented; (4) the river Dschagijr-gol, which empties into the western lake, is shown under the name of Dykbulak, and in its upper course as the Jalun-tschan, an important tributary of the upper Jang-tse. In a word the Indian map of the Pundit is but a travesty of the reality.»*

The slips here enumerated as occurring on the Pundit's map are not sufficient to warrant Prschevalskij's general condemnation of its value. That the former only entered *one* lake at the sources of the Hwang-ho was of course simply due to the fact that he only saw one of the two; and as for giving a wrong name to a river, that is an error into which, as Rockhill has proved, Prschevalskij himself fell several times. Besides, in the matter of the reliability of the Pundit's map we have only to put Rockhill's and Walker's opinions against Prschevalskij's. Taking the purely geographical results, the Pundit's journey yielded at any rate a more valuable output than Prschevalskij's fourth journey, even though his details do have to be corrected in respect of several points.

* *At Kjachtij na Istoki Scholtoj Reki*, p. 143 ff.

CHAPTER XXX.

VARIOUS TRAVELLERS IN NORTHERN TIBET. — PRSCHEVALSKIJ'S FOURTH JOURNEY.

This brings us to the journeys in northern Tibet, about which a few words may be said. Prschevalskij began his fourth journey in October 1883 and finished it in October 1885. The distance covered amounted to 7815 km. From Kjachta (Kiakhta) he crossed the Desert of Gobi, and strange to say by a route which he had traversed twice, and even in some places three times before, then through the highlands of Kan-su, north of Koko-nor, and so reached the two lakes, the Dscharing-nor and the Oring-nor, in which the Hwang-ho takes its rise. After a side-trip to the upper Jang-tse-kiang, he proceeded farther through Tsajdam and over the Astintagh to Kara-koschun. From there he continued towards the west, along the northern foot of the Kwen-lun as far as Chotan, then followed the course of the Chotan-darja, and finally reached home across the Tien-schan.

At the time when Prschevalskij performed this his fourth journey the northern border districts of Tibet were not particularly well known, but his journey gave as it were the impulse to several other enterprises in the same direction, though but few of them will bear comparison with his from the geographical point of view. Attempts to penetrate to Lhasa became *en vogue*, an enterprise in which not only did Prschevalskij fail, but all his European successors were not more successful than he was, until at last the holy city was entered by the English political mission of 1904.

In the year 1889 the Austrian Dr. Joseph Troll intended to penetrate into Tibet from Kaschgar, but after making certain investigations in East Turkestan, he contented himself with journeying to Kaschmir and India over the Kara-korum pass. The French traveller in Siberia, Joseph Martin, desired to make the same attempt, starting from Peking and travelling by way of the Koko-nor, but was prevented by illness; instead of that he made his way by the Central Asian lowlands to Kaschgar, and died in Margelan. But real importance attaches to Grombtschevskij's journey, lasting over 1 1/2 years, in Pamir, Kara-korum, and Western Tibet, in the course of which he mapped 7600 km. In May 1890 he attempted, but without success, to penetrate into western Tibet from Polu. Returning to Polu and Chotan in the

middle of June, he then spent a couple of months in the exploration of the Tisnab valley and the middle Jarkent-darja, as well as the water-divide between the two rivers. So far as I am aware, he has never published any detailed and connected account of his journey, but his maps have been published by the Geographical Society of St. Petersburg. Of Pjevtsoff's journey in 1889—91 those parts which possess direct interest for us have been already touched upon in the preceding pages (vol. III). His companions Bogdanovitsch, Roborovskij, and Kosloff have done excellent work in mapping the extreme north of Tibet. The later expeditions of the two last-named belong to a part of the extreme east of Tibet which does not at present directly concern us. And now a few words with regard to earlier journeys in the border regions of Tibet. These are far more numerous in the western parts than in the eastern; it has been less difficult to carry on exploration there because of the relative nearness of India as a basis of operations. In the year 1857 Adolph Schlagintweit travelled from Kara-korum to Kilian, Karghalik, and Kaschgar and was the first European to reach this city from India, but he was murdered there by Vali Khan. In the summer of 1863 Montgomerie despatched Mahomed-i-Hamid northwards from Leh, his object being to take astronomical observations and make topographical measurements. His route was over the Kara-korum pass and *viâ* Kara-kasch and Kilian to Jarkent, where he remained until the spring of 1864; but he died on the return journey to Leh.*

On the 27th May 1866 W. H. Johnson began an important journey from Kaschmir, where he was employed in trigonometrical surveying. He was the first European who reached Chotan over the Kwen-lun, and had a friendly reception from the khan of the place; he was also the first European who in modern times visited Kerija. After a stay of sixteen days he left Iltschi (Chotan) on the 4th October and started back by way of Sandschu, Schahidulla, Kara-kasch, and the Kara-korum pass to Leh.** After reading Prschevalskij's account of the impossibility of penetrating through the Polu defile, it is somewhat surprising to find the following expression of opinion on the part of Johnson: »The route *viâ* Rudok and Polu, although circuitous, has many advantages over others, the chief of which are that wood, grass, and water are obtainable at every stage; that the road passes over no rugged and high snowy ranges like the Sarsil and Kara-korum passes; and that it is safe from robbers.» And a little before that he says, »The only hindrance to this route . . . is the opposition of the Tartar shepherds of Rudok, who, I am of opinion, could be induced to allow traders to pass through their country by the offer of a small pecuniary payment guaranteed by the British Government.»

When at Polu Prschevalskij was given the following information about this route, as he records in his account of his fourth journey: »At Polu we learnt that a little way farther up in the ravine of Kurab there is a route over into Tibet, but the track that leads that way is exceedingly rough, and moreover had not very long before been deliberately made worse by the Chinese. Formerly that was the route

* *On the Geographical Position of Yarkund and some Other Places in Central Asia.* By Captain T. G. Montgomerie, in *Journal of Roy. Geog. Soc.*, vol. XXXVI. (1866).

** *Report on a Journey to Ilchi, the Capital of Khotan in Chinese Tartary.* By W. H. Johnson, in *Journ. Roy. Geog. Soc.*, vol. XXXVII. (1867) pp. 1 ff.

by which the gold-prospectors made their way into Tibet. Occasionally it has been used by Tibetans travelling with medicines to sell. In the year 1871 it was traversed by a pundit, who journeyed from Ladak to Kerija and back. In 1877 the road was improved a little by order of the ruler of Chotan, Nias Bek, who contemplated using it as a means of retreat to India in case of the collapse of Jakub Bek's power. After that it was again neglected and became as unserviceable as before. In order to convince myself whether the road really was as bad as it was represented to be, I set off with two Cossacks up the river. At first the road is practicable for pack-animals, but very soon it contracts into a short, wild defile, with the swift Kurab boiling along its bottom between the high cliffs. When the river is in flood it is impossible to ford it. Sterility reigns everywhere; grazing exists in only a few localities. It was with the utmost difficulty that we succeeded in penetrating some 12 verst up this defile. In some places it would be absolutely impossible to advance with pack-animals. Having pitched our tents at a distance of 21 versts from Polu, I proceeded with a guide two versts farther up the defile to a spot where there was said to be a bridge which had been purposely destroyed by the Chinese. I found that they had blocked up the passage with stones and brushwood; this would certainly not have stopped us had not the defile itself grown worse. Even with a minimum of baggage it would be impossible to advance, especially when the summer flood fills the gorge. And even though we had succeeded in forcing a passage at the cost of part of our baggage and some of our horses, and so succeeded in reaching the Tibetan plateau, the horses after such terribly trying exertions would have been quite incapable of continuing the journey. These various considerations compelled me to abstain from persevering in my attempt to penetrate into Tibet by that route.»

And yet that very road was used by Kishen Singh, who took part in Forsyth's expedition from Kerija to India. He does however speak of a difficult bit of road south of Polu. In the year 1885 Carey also travelled through the Polu pass. Colonel Trotter, a member of Forsyth's expedition, proposed to have this route made practicable for traffic between India and East Turkestan, and the plan would have been all the more favourable in that it did not touch the territory of the Maharajah of Kaschmir. The plan was however knocked on the head by Carey, who reported that the pass south of Polu was so inaccessible that it was impossible to traverse it with animals laden with merchandise. That the road through the Polu defile really is very difficult is quite clear from the descriptions of it given by Dutreuil de Rhins and Deasy, to whose journeys we shall return in more detail presently.

But there are certain other pioneers in the extreme west of Tibet who deserve not to be forgotten. In September 1867 Robert Shaw began his journey from Leh over the Kara-korum pass to Schahidulla, Sandschu, Karghalik, Jarkent, and Kaschgar. He returned by the same route, and was the first European who reached Kaschgar after Schlagintweit. He was also the first traveller since Marco Polo who brought home an account of Tschertschen and the way to it; for though it was indeed only based upon hearsay, nevertheless even that was of value.*

* Cf. R. Shaw, *Visits to High Tartary, Yârkand, and Kâshgar.*

In May 1868 Hayward started from Leh and at Schahidulla met Shaw. The former explored the sources of the Jarkent-darja and investigated the upper course of the river. Then *viâ* Karghalik, Jarkent, and Jangi-hissar he made his way to Kaschgar, the position of which he determined astronomically. Through his journey it became possible to conjoin the Russians' explorations in the north with those of the Englishmen in the south. He concluded his journey in 1869, and was murdered in the year following.

In 1870 Forsyth undertook a politico-commercial journey from Leh to Jarkent in the company of Shaw. Forsyth's second expedition to East Turkestan falls in the years 1873—74, when he led the big commercial mission to Jakub Bek. Their route lay through Leh, Schahidulla, Sandschu, Karghalik, and Jarkent, and so to Kaschgar. During the course of the expedition the members of it made excursions in various directions. The first of these was to Artisch and Ordan Padschah. In December 1873, Gordon, Stoliczka, and Trotter travelled across the Tienschan to the Tschatir-kul, and at the same time Captain Biddulph journeyed to Maral-baschi. In February 1874 Forsyth made an excursion with Bellew, Chapman, Trotter, and Stoliczka in the Artisch district, and from there the two last-named made their way to Utsch-turfan. In March 1874 Gordon, Biddulph, Trotter, and Stoliczka proceeded over Pamir to Wachan; and finally the Pundit Kishen Singh returned, as I have already stated above, through the Polu defile to India. The journeys to East Turkestan of that enterprising and able commercial pioneer, Andrew Dalgleish, were possessed rather of trade interest. In the year 1882 he led a caravan to Jarkent and spent ten months in East Turkestan. Two years later he undertook a fresh trading expedition to Jarkent, and in 1885—86 he took part in Carey's circuit of Central Asia, compiling at the same time a map of the journey. And it was whilst on his way to Jarkent again that he was murdered in the year 1888 at the Kara-korum pass, as related above (pp. 417—418).

Younghusband's great journey across Asia belongs to the year 1886, and in the course of it he too crossed the highlands between Pamir and Western Tibet, where his route lay west of those of which I have just been speaking.

Since the period which I have thus briefly dwelt upon Western Tibet, Pamir, and the mountainous country between the two has been relatively well explored. Just as the establishment of a Russian consulate in Kaschgar gave rise to a fairly accurate investigation of the inhabited parts of East Turkestan, so the settlement of an Anglo-Indian political agent in the same town led to several journeys of a more or less scientific character being undertaken between India and East Turkestan; and then also the inclusion of Kandschut and Gilgit within the English protected area likewise gave occasion to an accurate mapping of the adjacent regions. This part of the highlands is therefore now fairly well known. On an itinerary map of Tibet the various travellers' routes would all run together in a compact faggot near the extreme west of the country, but would become increasingly less numerous, that is they would run at greater and greater distances from one another, the farther you proceed east, where there still exist extensive patches of white on the map of Tibet. In the extreme east the routes would again fall closer together. From such a map we should be able to deduce certain conclusions with regard to the country's practicability or relative

difficulty of access. Where the routes run close together the difficulties are less; where they are fewest and farthest between, there the greatest difficulties are found to exist.

In the foregoing paragraphs I only desired with the utmost brevity to call to mind the most important journeys in that part of western Tibet in which I also travelled; but I have passed over all those which fall outside that area, as for example the explorations that were made by the English members of the Anglo-Russian Boundary Commission on the Pamirs in 1895, Stein's journey, and several others. Journeys made in the extreme east of northern Tibet, and still more journeys in the eastern Kwen-lun, do not for the present concern us in any way, notwithstanding that those regions have been the scene of several distinguished and famous exploring expeditions. I need only mention names like Michaelis, Szechényi and Loczy, Bell, Gill, Bonin, Roborovskij, Futterer and Holderer, Kosloff, Filchner, and Tafel, the last of whom may be expected to bring home with him information of very great importance. The Nan-schan system has been the scene of Obrutscheff's journeys, which count amongst the most admirable that have ever been carried out in Asia and far excel those of any other Russian explorer.

I have already referred in brief extracts to the course of Prschevalskij's fourth and last journey, and will now proceed to quote a few short excerpts from the Russian account of his travels, the only version published. Of the source-region of the Hoang-ho he gives the following characteristics: »Odon-tala has a length of 75 km. and a breadth of over 20, and stretches from north-west to south-east. The whole of that region, which was formerly the bottom of a vast lake, is at the present time a series of marshes, springs, and small lakes. According to our barometrical observations its altitude above sea-level amounts to 4270 m. The depression is surrounded by mountains: for instance, on the north is the Akta and on the south the water-divide between the Yellow and Blue Rivers. Besides, Odon-tala is traversed by various small streams, two of them larger than the others; these are the head-streams of the Hoang-ho. One of them is probably identical with the Altijngol of the Chinese accounts. Our bivouac, which was situated three versts east of the confluence of these rivers, was, according to my calculations, situated in lat. 34° 55′ 3″ N. and 96° 52′ E. from Greenwich. Above the great lakes the valley of the Hoang-ho is 5—10 versts broad and forms a steppe-like plain, thickly dotted over, south of the river, with marshes and small lakes. The grazing was good, but there were no traces of inhabitants. In the source-streams we found a great quantity of fish, belonging principally to the genus *Schizopygopsis;* they probably make their way there from the great lakes . . . . . The country south of Odon-tala again reaches an altitude of close upon 4600 m. In respect of its flora and fauna this region resembles other parts of north-eastern Tibet. The marshy character of the country does not cease until you reach the water-divide between the Yellow River and the Ditschu (the upper course of the Jang-tse-kiang). That divide, which forms the eastern continuation of the Bajan-kara-ula, has an altitude of 4480 m.

The water-divide between the Yellow and the Blue River, where our route crossed it, was almost imperceptible, but nevertheless it impresses a characteristic stamp upon the neighbouring country. To the north of it is a plateau of

the usual Tibetan character; south of it rises an alpine region, with lofty cliffs, steep and difficult to climb. At first these do not reach up to the snow-line, which runs there at an altitude of 5200 m. But with every ten or a dozen versts that you advance towards the south this alpine country assumes an increasingly wilder appearance, and ere long you catch a glimpse of the snow-capped mountain-peaks of Gatij-dschu. At the same time the chains acquire a meridional direction, and both vegetable and animal life increases. The rocks consist almost exclusively of schist. Out of every ravine issues a small swift torrent, which joins the Di-tschu, and in summer these carry a good deal of water. Higher up the river's course the relief is gentler, and the country merges gradually into the Tibetan plateau. The climate in this region is extraordinarily harsh, as it is throughout the whole of Tibet. According to the statements of the natives snow falls in winter to a considerable depth and the cold is intense. Even in spring it is cold and stormy; in the summer it rains or snows every day, and even the autumn is disagreeable.»

As I shall in a later chapter attempt to summarize our existing knowledge about the orographical structure of the middle Kwen-lun, it will not be without interest to recall the opinion with regard to it which Prschevalskij held twenty years ago. I will therefore append here what he says about it; it will also serve as a specimen of the way in which he describes a complicated mountain-system. »The famous Kwen-lun, the 'backbone of Asia' as Richthofen calls it, was, before my last journey, perfectly unknown over a distance af 12°, counting from Naidschin-gol to the neighbourhood of the oasis of Kerija in East Turkestan. We now succeeded however in penetrating along this unknown part of the oldest mountain-range in Asia, and gleaning some light as to the topographical arrangement of the principal massive of the system. The main chain makes a curve, the two extremities of which lie on almost the same latitude, namely 36° N., whereas the tangent of the curve lies on 38° N. The western boundary of the Kwen-lun may be put at 87° E. from Greenwich, where the Altin-tagh breaks away from the main chain. On the other hand the middle Kwen-lun stretches eastwards, according to Baron Richthofen's investigations, as far as 104°, after which it widens out to a broad system of parallel ranges. The most imposing of these, that is the Kwen-lun proper, serves, like the whole of the western part, as an immense border-wall to the highlands of Tibet, and in the east stretches to the desert and the salt marsh of Tsajdam. Farther east it is cleft by the upper course of the Yellow River, and finally dies away in the interior of eastern China. That this range really does constitute the Kwen-lun proper is evident from the fact, that it is the only one which is uninterruptedly connected with the main chains both east and west, the entire system thus stretching over more than 40° of longitude, whereas all the other parallel ranges terminate near the meridian of Lan-tscheo. My own explorations later on in this journey resulted in my discovering an immense snowy range which breaks away from the western Kwen-lun near the transverse glen of the Kerija river, so that this cannot be regarded as the main range of the system; although it is reputed to extend for a whole month's travel in a south-easterly direction, and is perhaps connected with the Tan-la or with mountains north of the Tengri-nor, and thus ends before the true main range does, in that it leans upon the meridional chains

which accompany the Indo-Chinese rivers and the upper course of the Jang-tse-kiang. The main range of the central Kwen-lun is everywhere double, indeed in places three-fold. Like most of the border mountains in Central Asia, this range also is remarkable for its rugged and mountainous character, a feature especially pronounced on its northern side, whereas the southern flank next Tibet is very much shorter and possesses much softer outlines. In the eastern half of the middle Kwen-lun, which I explored during my third journey, we find overlooking Tsajdam the outside ranges of Burchan-Budha, Go-schili, Tolaj, Toraj, Tsosone, and Dsukha, all of which have an east-west strike. Parallel with this outer barrier run the ranges of Schuga with its continuation to the snowy mountains of Amne-matschin, Gurbu-gundsuga, and Gurbu-naidschi. The third parallel range is composed of the Marco Polo chain, which begins at the Schuga river; this I explored as far as the snowy group of Charsa. Thence the great Tibetan border range extends west-north-west, still retaining its double or three-fold character. Thus we find next to Tsajdam the glaciated massive of Dschin-ri, from which the Garinga-ula stretches towards the east-south-east, and the Columbus chain towards the west-north-west. Fifty versts south of Dschin-ri lies the great range which the Imperial Geographical Society has called Prschevalskij Chain. North of the Columbus and Garinga Chains comes the Tsajdam Chain, separated from them by a narrow valley, through which flows the Chatin-san. Corridor-like long-axial or latitudinal valleys of this kind are characteristic of this part of the Kwen-lun. The westward continuation of the Columbus Mountains is formed of the Moscow Chain, which again is connected with the eastern part of the Tokus-daban. North of these the Altin-tagh breaks away to the east-north-east, as do also the two ranges of the Tschamen-tagh and the »Nameless» Range. The Tokus-daban itself runs towards the south-west, and joins the immense main range of the western Kwen-lun, which, covered with perpetual snow, forms the southern boundary of the Tarim basin. I have called its eastern portion the Russian Range. It is in this part of the system that the western end of the Prschevalskij Range is to be sought for. In the western part of the middle Kwen-lun the prevailing rocks are quartz phyllite, granite, and quartzite. The following are especially distinguishing features — the considerable altitude, the great number of peaks crowned with perpetual snow, the absence of cliffs, particularly in the snowy groups, the small number and insignificant size of the rivers, and the amazing sterility. Both the fauna and flora are poor, but gold occurs plentifully, a circumstance which in the future will be sure to have the strongest attraction for the covetous European.»

Finally, I will venture to reproduce one or two short extracts from Prschevalskij's description of the Tschimen valley, which he discovered during his fourth journey. Just as I had my headquarters at Temirlik, so he had his at Tschong-jar, and from there he made an excursion of close upon two months' duration into the far north of Tibet, covering in the course of it 784 versts. Here too his nomenclature is in a high degree confusing: sometimes he seems to use Mongol names, sometimes he employs invented Russian names, which give no hint whatever as to the nature of the object that they describe, and it is but rarely that we find the true, traditional, and illuminating name. »We started on the 19th November (O. S., 1884) and decided in the beginning to make westwards through the big, boundless

valley which, because of its incessant winds and storms, I called subsequently the Valley of the Winds. Our first stage was one of 35 versts without water across a perfectly barren plain covered with sand, loess, and fine gravel, the rise being 400 m. We started in the afternoon, rested during the night, and continued again early the following morning as far as the locality in which the Sajsan-sajtu,* in consequence of the greater steepness of the surface, disappears underground, though it emerges again in the form of springs at Tschong-jar and the salt marsh of Ghas. These springs give rise to rivulets, which, after they unite, run out into the south-west corner of the lake of Ghas. The river Sajsan-sajtu comes down from the glaciers on the southern face of Mount Kreml, separates the Moscow Chain from the Columbus and Tsajdam Chains, and then wheels east into the Valley of the Winds, shortly after which it disappears into the ground. After flowing 20 versts underground it again comes to light in the form of a multitude of springs, which eventually unite and give rise to a fair-sized river; though farther down this once more disappears underground. We measured the breadth of the stream on the ice, and found it between 40 and 50 m.; the ice was 2 1/2 feet deep, the water under it only 1 1/2 feet deep. The valley through which the river flowed had a breadth of one or two versts. Its surface consisted of loess and sand, brought thither by the winds. The grazing was in general good. On each side of the valley reaching to the foot of the mountains on the north as well as to the foot of those on the south is a barren stretch with a tolerably steep slope. We now changed from a westward to a south-westward course, and then turned south where the Sajsan-sajtu breaks through the Tibetan border mountains.** Into it we then plunged, our intention being, first to visit the Tibetan plateau and then to return to the Valley of the Winds, which we now left on our right hand extending a long way towards the west. Here the main range of the middle Kwen-lun is a good deal lower and its outlines less wild and inaccessible. The glen of the Sajsan-sajtu, which was very easy even for camels, serves as the boundary between the Tsajdam (= Tschimen-tagh and Piaslik-tagh) and Moscow (= Atschik-kol) Chains. These border-ranges are almost entirely barren, and in great part covered with loess deposits. The eastern half of the Valley of the Winds, in which we were now travelling, is bounded on the north by the Tschamen-tagh (= Ilve-tschimen and Akato-tagh), about which I had heard speak whilst still in the neighbourhood of Lop-nor. This range has an east-west strike, is 100 versts long, and is connected at the one end with the Altin-tagh and at the other with the Nameless Range that lies north of Ghas. It attains a considerable altitude, rising in three places above the limits of perpetual snow. We were told that on its northern face a river originates, which, after breaking through the Altin-tagh, empties into the Lop-nor. This is probably the Tscharklik-darja. This mountain-range, like the adjacent valley, is absolutely barren. There is an entire absence of springs and brooks. The mountain slopes are very steep and in the upper regions are strewn with drift-sand. The transverse glens too are steep, confined, and unfertile. South of the Valley of the Winds and of north-western Tsajdam is the stretch of mount-

* By this he means the Jusup-alik river, which is formed by the Toghri-saj, At-atghan, and several other streams, and flows past Ghaslik and Bagh-tokaj.

** He means the lower part of the transverse glen of the Toghri-saj.

ains which I have called the Tsajdam Chain. It too is sterile and ill-supplied with water, but it contains a great abundance of loess deposits. South of this again rises the stupendous mountain-range which I have called after the discoverer of the New World. The eastern half of the Columbus (= Kalta-alaghan) range is covered with perpetual snow. To a third range, which forms the westward continuation of the two last-named, and borders on the south the Valley of the Winds, was given the name of the Moscow Chain (= Atschik-kol). This is connected on the west with the Tokus-daban. It is almost entirely covered with glaciers and these are biggest in the middle where the Kreml peak is situated. After two short stages southwards from Sajsan-sajtu we reached the plateau of Tibet. Before us stretched the vast, limitless plain in every direction, vanishing at length on the eastern horizon. In the south and south-east rose a chaos of less important mountains; but beyond them gleamed the snowy peaks of the range which subsequently received my name. In the middle of the plain lay, finally, a large, elongated lake, which to our astonishment was not yet frozen over; I called it the »Non-freezing lake. It lies at an absolute altitude of 3570 m.* The water was of a beautiful dark blue colour, but so salt that probably it never freezes; at all events in the beginning of December, with the thermometer registering 34.4° of frost, we found only a narrow fringe of ice along the shores. Underneath this ice-fringe the water had a temperature of —11° (at 2 p.m. on the 8th Dec.). The night was still and the cold intense, and a thick mist spread across the entire lake, looking under the beams of the rising sun like a beautiful transparent white veil. Towards the west the lake is very shallow, and there it receives no affluent; but its eastern half is probably entered by rivers which flow off the Columbus Chain and of that which bears my name. At first I called the last-named the Mysterious (Sagadotschnij), because we only saw it at a distance, and its highest summit I christened, because of its shape, the Schapka Monomacha. As, from what we could apparently see, this immense range stretches towards the west, it is not improbable that it is connected with the Russian range or the Tokus-daban, and thus forms the principal crest of the middle part of the Kwen-lun. The icy west wind blew straight in our faces. Sometimes a little snow fell and storms were not infrequent. On the 15th December we encountered an especially memorable tempest. It began in the morning and continued until the afternoon. The excessively violent gusts of wind whirled clouds of sand and dust into the air, and notwithstanding that it was the middle of the day we were enveloped in a thick yellowish grey mist; at a distance of 30 or 40 paces we could see nothing.»**

In this passage we have the results of the first reconnaissance of the extreme north of Tibet, the region between the Arka-tagh and the Astin-tagh, of which I have given a more detailed description in the third volume of this work. In this journey, as in the three which preceded it, Prschevalskij succeeded in penetrating an unusually long way into Tibet. In fact his journeys are astonishing, especially when we remember that he was the first explorer of the heart of Asia. In this respect his first journey of 1870—73 was also without doubt his most remarkable; neither in length nor in the results obtained was it exceeded by any of the other three which followed it.

* According to my observations 3867 m.

** Prschevalskij, *At Kiachtij na istoki Scholtoj Reki, isledovanije Severnoj Okranij Tibeta i put tscheres Lob-nor po Bassejnu Tarima* (St. Petersburg 1888).

CHAPTER XXXI.

JOURNEY OF WELLBY AND MALCOLM.

In this review of exploring journeys in the north of Tibet, I have ignored, as will be seen, the chronological order, preferring to follow a regional division of the area. Prschevalskij's fourth journey has carried us to northern Tibet. South of the region in which he thus worked, and south of the routes traversed by the members of the Pjevtsoff expedition — of which I have given an account in the third volume — runs my own route of 1896. South of this again we find Wellby and Malcolm's route of 1896 in the big latitudinal valley between the continuation ranges of the Koko-schili and the Dung-bure; and I will now pass on to the consideration of the principal geographical results of that journey. In many respects it was a remarkable journey, not the least notable feature about it being its great extent through a perfectly unknown region; and it was attended by the greatest difficulties, and resulted in the partial destruction of the caravan. The starting-point was Leh, and the route chosen was *viâ* Panggong-tso to Niagzu, which place was left on the 18th May 1896. A couple of days later the travellers passed the salt lake of Treb, whence Ladak derives its supply of salt. There Wellby made the same observation as all other Tibetan travellers, namely that the lakes are shrinking and are on the point of disappearing. He says: —

»We were almost tempted to try a swim in the salt water, but on close examination we found the shore sloped down in terraces to the water's edge, where it became soft and treacherous. All this distinctly showed, that the size of the lake must have been for many years gradually decreasing, and one is led to believe that such is the case in regard to most salt lakes in Tibet. The water, we were surprised to find, was not nearly so brackish as the surroundings would have induced one to believe». Strange to say the lake of Treb is elongated from north to south. East of its southern extremity lies the pass of Napu-la, which according to Wellby reaches an altitude of 18,434 feet and according to Deasy of 19,000 feet. A little way east of that pass, in the district of Kerambutabuk, Wellby was prevented by men from Rudok from proceeding farther in the direction of the Forbidden Land. He had the same experience as all other travellers who have attempted to penetrate towards Lhasa, although he was stopped at a greater distance from the city than

any of his predecessors. Not only was he forced to return to the Lake of Treb, but he was not even allowed to go back by the shorter road *via* the Mang-tsa-tso.

On the 29th May he crossed over the pass of Lanak-la, on the boundary between Ladak and Tibet, which had been used five years before by Bower. The grazing was in general good; anyway it was better than it was farther up on the highlands. Water was somewhat scarce. Over on the other side of the pass the travellers found themselves in a latitudinal valley, which, although it ran from south-west to north-east, nevertheless was of assistance to them. »Thus the actual finding of our way was not such a difficult undertaking as one might have expected. We could see the valley stretching far away to the east, and calculated that we had some days of clear sailing before us.» — The wind blew generally from the west or south-west. — »A strong wind was blowing from the south-west, enough to cut us in two, and as the skies clouded over pretty quickly, we had no chance of taking any observations.» Meanwhile the vegetation decreased again and the travellers got astray in a very barren region. Between camp No. 18 and camp No. 19 they found »a large salt-water lake. There was but poor grass around, but a stream of good fresh water. Ahead of us, on all sides of the lake, the land appeared absolutely barren and arid, possibly on the southern side there might have been a little hidden grass . . . . By reason of the late snowstorm, the going along the edge of the lake was heavy in the extreme. . . . The land was barren and useless to a degree, with no chance of finding any fresh water or grass; the former difficulty was overcome by collecting some snow, and the latter by being extravagant with our bhoussa. The ground fell in terraces from the hills that rose up some distance from the lake, and was split up by several deep, narrow and harsh nullahs running into it. . . . As far as we could see, a barren salt land extended due east, and we were following a regular zone of salt country, and to get clear of this belt, it was advisable to strike north. . . . Early in the afternoon we came to a stretch of fairly good grazing, and in the sandy nullah close at hand, a foot or so beneath the surface, flowed unlimited water. Antelope were plentiful and tame around this spot. . . .»

North-east of the lake they crossed over a pass; and of the country which they found over on the other side of it Wellby says: »As soon as we had completed the descent we found a broad valley stretching east and west, apparently to eternity.»

To a large freshwater lake, then completely frozen over, was given the name of Lake Lighten. There the grazing was good, and wild-geese, antelopes, and kulans were common. »On the 13th of June we camped by another salt lake. From the top of a pass we had been rewarded with a very fine view of it, for the water under a cloudless sky was of a wonderfully bright blue, backed as it was by massive snow mountains, but detestable when near for its uselessness. As we marched along its banks, the heat was intense, the maximum thermometer registering 105° in the sun, and although there was no fresh water to be seen, we found some by digging. . . . In a little nullah we found three stones, which from the way they were placed showed that they had been used for a fireplace, but not at any very recent date, more likely two or three years ago. This was the first sign of mankind since

leaving Lanak La, and had probably been made by some nomads who had wandered in this direction.» A short distance farther on in the same latitudinal valley they crossed a number of very shallow freshwater lakes, the mud in the bottom of which was however so soft and treacherous that a part of the caravan nearly got lost in it.» This appeared to be the nature of the soil for some distance round the lake; we judged that its size varied in accordance with the rainfall. From this lake two routes were open to us, one running in a somewhat northerly direction, through a good, grassy, watered valley, which we should have liked to have taken; but as the other route led almost due east, we took it, and perhaps made a wrong decision, for we came to a dried-up country, with small salt lakes, and had to dig deep in a dry river bed for water.» By this, although they were only 150 miles from Lanak-la, they had lost 18 out of their 39 caravan animals. Wellby gives the following characteristics of the country as he saw it from a hill in that locality. »South-east of us lay a fine range of snow-mountains, and I reckoned that if we could manage to steer just north of these, there would be no more difficulty about water to annoy us. All the ranges, large and small, seemed to run east and west, and it struck me how much more difficult, for this reason, it would be to traverse Tibet from north to south. Directly south of us, some sixty or eighty miles off, was another magnificent snow-range with enormous white peaks. Some six or eight miles south-east was a dark blue salt lake, with two other smaller ones nestling close to it, and in the nullah immediately south of us grew grass which, for this country, was rich. Far away to the north again loomed another mighty snow range.»

After that they crossed over an easy pass in the latitudinal valley, 17,000 feet high, and then approached another saltwater lake, which was frozen in the middle only. There a flock of wild-geese were resting. As wild-geese are mentioned pretty frequently by various travellers in connection with the freshwater lakes of Tibet, it may be assumed that they cross over the highlands by several different routes.

The following remarks by Wellby are fairly characteristic of the highlands of Tibet: — »A climate like this at such a height struck us as truly marvellous. After seventeen degrees of frost by night, we found ourselves basking in the open in a temperature of 106 degrees, showing a variation of ninety degrees in the twenty-four hours. At 7 p. m. again, the thermometer registered as much as forty-eight degrees Fahr. . . . Owing to the impossibility of marching with the sun so powerful, we decided to make two short marches each day, one of three hours in the very early morning, and the second during the afternoon. . . . Our route, as far as we could make out, lay over a large open plain with but scanty grass, and far off we could see a hill standing out alone conspicuously, a useful landmark for us to march on to. Without a distinct feature to make for, the caravan would very often zig-zag down a broad valley and perhaps cover a mile or two more of ground than was necessary.»

Between camp No. 35 and camp No. 36 they crossed a not inconsiderable river flowing towards the north-east and north, which probably emptied itself into some lake. From the 29th June he notes that the lofty range to the north continued to be distinctly visible, »and we conjectured it must be a part of the Kuen Lun.»

»During the night of the 2nd July some snow fell. . . . We passed through a very barren, sandy country, so much so that it was no surprise to us at not finding the remotest trace of any one ever having been there before. . . . We passed through a sandy, stony country, with low ranges of hills on either hand, and further off another large range running as usual almost east and west.» The 4th July they travelled down a pleasant grass-grown valley.

During the succeeding days they travelled mostly towards the east through the big latitudinal valley; the country was desolate. By this the number of caravan animals had dwindled down to fifteen. Camp 49 was made near a salt lake, elongated as usual from east to west. Farther on we read: »I went on ahead, and so bare was the aspect that it looked as though we should never see any water or green again; everywhere the ground was incrustated with salt; all the nullahs were white with it, and to all appearance we were leaving bad for worse.»

One or two days later they approached »the bed of a salt lake partially dried up.» The animals almost perished in the soft marshy ground. »It is impossible to picture such a barren land as we were in, and it seemed as though there would never be an end to it as long as we pursued our eastern course.» They endeavoured therefore to strike a more northerly route, but only succeeded in finding a fresh salt lake. At last however they did discover grass and water.

At Camp 51 on the 10th July, strange it may sound, Wellby abandoned one or two of his men and a horse, as well as all the provisions they were able to do without. He states that his reason for doing this was, that the men were unable to keep up with him any longer. Farther on his other attendants, except three, ran away from him and were never heard of again. I subsequently found these men in a very reduced and exhausted condition in Tenkar, where they were supporting themselves by begging in the streets. I allowed them to return with the men whom I dismissed in Tenkar, and having procured Chinese passes, they travelled along Chinese routes back to East Turkestan.

After that the country proved somewhat more favourable for the travellers and occasionally they came across water and grazing. On the 13th July they rested beside a couple of small freshwater pools. On the following day one of the mules was very nearly suffocated in the soft ooze around a freshwater lake. Very often they had to cross at right angles over a number of small watercourses (nullahs) streaming down off the mountains to the north or south. Occasionally we read about violent tempests from the north. I also experienced similar storms in northern and eastern Tibet, although they form an exception to the usual wind, which blows from the west. At Camp 56 they found good grazing. The ground was frequently made still softer by the snow that fell. The shores around the lakes in that part of Tibet are at that season of the year, the latter half of July, often very soft. For instance we read, »We halted by a lake whose water tasted very nearly fresh, but the banks were so treacherous that it was a hazardous undertaking to get close to it, and after our precious experience we preferred digging instead. One characteristic trait of the climate of the highlands, a trait which I also observed on several occasions, is that you can often see the storms, with their dense masses of cloud, drifting past you to the north or to the south without their touching you. Wellby, speaking of

them, says, »Throughout the day storms continued to rage around us amidst the adjacent hills, but, fortunately, none fell actually over us.» On the 20th July he writes: »the whole country appeared to be changing for the better, . . . everywhere there was more grass growing. . . . We were, too, making a very gradual descent, and felt convinced that, with such natural signs, we must before very long hit upon streams which would lead us to some sort of civilization.»

The following information is important for the mapping of Wellby's route. »Just after leaving Camp 62, we were all struck with wonderment at finding a track running almost at right angles to our own route. It was so well defined, and bore such unmistakable signs of a considerable amount of traffic having gone along it, that we concluded it could be no other than a high road from Turkestan to the mysterious Lhassa, yet the track was not more than a foot broad. Our surmises, too, were considerably strengthened when we found the entire leg bone of some baggage animal, probably a mule, for still adhering to the leg was a shoe. This was a sure proof that the road had been made use of by some merchant or explorer. . . .»

This route was, as Dr. B. Hassenstein showed on the general map to my former journey, none other than the track made by Dutreuil de Rhins's caravan of 1893 and by Littledale's of 1895. I have said in Vol. III, that my Camp No. VIII in the 1896 journey was on Littledale's route. From that point he travelled south by precisely the same route that Dutreuil de Rhins and Grenard had used two years before. The point at which Wellby and Malcolm intersected their route lies immediately south of the lake which Grenard calls Lac No. 4. From that point De Rhins and Littledale diverged, the former travelling south, the latter south-east. Fortunately the signs of their passage were still so distinct at the time of Wellby's journey, that they afford an excellent means of checking his route on the map. We shall return to Lac No. 4 when we come to deal with Grenard's journey. Wellby, who intersected it in its southern part, says of it, »A mile or so farther on we came to the dried up salt bed of a very ancient lake. The salt was in every shape and form of crustation, and the whole lake for several miles across was divided up into small squares with walls one to three feet high, rugged and irregular. The going across this was troublesome and arduous. . . .» Further on: »The following morning we came to a most dreary-looking region, ornamented only with a big salt lake, without any vegetation or kind of life, making us eager to get across such a solitude.»

On the 27th July they forded a river flowing towards the north and coming down from a mountain range stretching east and west and overtopped by big snowy peaks, from whose glaciers and snow-fields a number of brooks gathered into the principal river, which itself empties into a lake of medium size. In that region the grazing was excellent. There too they found three stones arranged in the form of an old fire-place. After that they travelled towards the east-south-east, still in the same immense latitudinal valley, which is separated by the Ḳoko-schili mountains from the latitudinal valley that lies to the north of it and in which I travelled a month later, bearing in this same locality also east-south-east. On the 31st July they forded a smaller stream, which came off the snowy mountains just mentioned and emptied

itself into a large salt lake, along the southern shore of which they travelled. Off the snowy range to the south a great number of brooks run down into this lake. The surface adjacent to these was usually excessively soft and treacherous. At the eastern end of this lake Wellby intersected Bonvalot's and Henri d'Orléans's route of the 1st January 1890. The rainy season had already begun, and Wellby says, »Soon after dark rain began to fall; it rains, as the saying goes, cats and dogs, such as we had never seen it rain before.» East of the great salt lake came a region with excellent grazing, good water, and any number of antelopes. Wellby then speaks of »a kind of oasis on rising ground»; similar small patches of vegetation occur also in other parts of Tibet. Curiously enough, at one of their camps in this region eight mules died in one night, due, Wellby thought, to their having eaten some poisonous herb. After that he was left with only three caravan animals. There too the ground was soft and marshy. »Although we selected the nullah that afforded the best road, still at each step the poor mules sank into the mud above their fetlocks, and sometimes they sank down altogether, when the load had to be taken off, the animal dragged out, and reloaded.»

In the eastward prolongation of the latitudinal valley they passed numerous quite small salt lakes. The lakes which I passed in the more northerly latitudinal valley were in general large. »As the mist lifted the day became warm and the three mules sank deeper than ever in the sodden ground.» On the 15th August the travellers touched for the first time, and at an altitude of 4860 m., a river which has its sources somewhat farther west and which they then followed for several days eastwards. »The river had swollen considerably, and flowed strong and deep, as though on some errand of weighty importance. . The water was stained to a dull reddish colour. Speaking of the same river lower down, Wellby says, »the river flowed thigh deep with a swift current, and was thirty yards broad.» When first they struck this stream, Wellby tells us that he took it for the Ma Chu. He followed it all the way down to its mouth in a large freshwater lake. »As we proceeded we discovered we had marched into a *cul de sac*. On our right hand our road was blocked by the river, now increased to double its size. In front of us stretched a fine freshwater lake, while on our left lay an arm of this lake, covering a distance of some miles to our rear. There was, under these circumstances, no alternative left. I should either have to cross this arm or march all the way round it. The first plan I attempted, but to no purpose, for the soil of the lake was too soft. . . . The grassy slopes with flowers and vegetation eventually rose into high hills, which again were backed by snow-capped peaks. On the south side of the lake a vast plain extended to distant mountains.»

Under almost precisely similar circumstances I too was compelled a month later to make a similar detour at a lake of nearly the same shape and size as Wellby's, and lying parallel to it, that is to say, stretching from west-north-west to east-south-east, but situated 60 or 70 km. north-north-east of the lake which Wellby encountered. My lake was also entered by a river coming from the west, although it was a smaller stream than Wellby's, and its course I followed down to its mouth, and afterwards had to make a circuit round its western arm. There exists however this essential difference between the two lakes: whereas my lake was a salt self-

contained basin, Wellby's was fresh. Immediately east of the latter begins the Tschumar or Namchutu-ulan-muren. Wellby, after marching for some days beside this, turned away from it into eastern Tsajdam, Koko-nor, and Tenkar. In so doing he intersected the routes of Rockhill, Prschevalskij, and Krishna successively, and then gradually worked his way into regions that are relatively well known.

Wellby cannot however be considered to have solved in a satisfactory way the interesting hydrographical problem which here confronted him, namely the question as to *where* the sources of the Tschumar really are situated. For three days he marched along the northern shore of the freshwater lake, and then he says, under date 26th August, »A short distance from the lake we were lucky enough to strike another small stream, that took its rise from some of the neighbouring hills. This stream flowed away in an easterly direction, sometimes sluggish, at others fairly fast. The water was clear with a sandy bottom, a few yards across, and only about a foot deep. In some places we could see numbers of tiny fish, which always made off at our approach. The banks of this little stream were sandy and grassy. We decided, whatever happened, to follow it. By so doing we knew we must be descending the whole time, and what was more important still, we knew we should never suffer from scarcity of water. . . . We made a double and pleasant march along the stream, which all the time was increasing in volume.»

On the 29th August, thus barely three days after they left the lake, we are told that the river was so big that it would have been rash to attempt to ford it. Several days lower down Wellby fell in with a party of Tibetan traders, from the chief of whom he gleaned a good deal of information. »To our great astonishment and delight he informed us that the name of the river where we had first seen his camp was no other than the Chu Ma, the very one we had been in search of. Without being aware of it at the time, we had actually discovered the source of the Chu Ma just after leaving the beautiful freshwater lake. We had also followed its course for nearly twelve days, a distance of about 120 miles. This river is also known to the Tibetans as the Ma Chu, and to the Mongols as the Napchitai-ulen.»*

But though this brief description leaves us in uncertainty as to the exact situation of the source of the Tschumar, the map on the other hand makes the position quite plain. It is shown as starting a few miles east of the north-east corner of the lake; and that there may be no doubt about it, we read there the words, »Source of Chumar». Wellby is clearly of opinion, that the river has no sort of connection with the freshwater lake. Nevertheless everything seems to point to the river being an effluent from the lake, or more correctly speaking, the lake is merely a vast expansion of the river, and its true source must be looked for a long way farther west, in the vicinity of Wellby's camp of the 10th August. From that locality, which lies at an altitude of 5060 m., the river flows steadily east until it empties itself into the lake, the altitude of which is 4800 m. There are one or two little irregularities in the altitudes on the map which ought to have been eliminated, for between Camp 90 and Camp 91 the river is made to flow 50 m. uphill! Camp 97 lies at an altitude of

* *Through Unknown Tibet*, by M. S. Wellby, pp. 60—203.

4790 m. or 10 m. below the level of the lake; the position is only 7 km. east of the lake and between the two there is not the slightest indication of a pass or threshold. It is not probable that a river, which only two days farther down is so large that it could not be forded, can arise without cause shown out of the level ground within such a short distance of the lake as these seven km. No, it is quite evident that the river forms the direct outflow of the lake, and this inference is confirmed by the statements, that the water of the river is *clear* and that of the lake is *fresh*. Dr. B. Hassenstein was also of the same opinion, when he traced out Wellby's itinerary on the map showing my journey of 1896; for in direct contradiction of Wellby's own map, he depicts the river as issuing directly out of the lake. It is however interesting to learn that Wellby's latitudinal valley drains seawards 180 or 190 km. farther west than the latitudinal valley which I followed. The sharp bend which the river makes to the north is also noteworthy. This occasioned Wellby's caravan some difficulty, in that the river there cuts its way through the Koko-schili, and enters the latitudinal valley on the northern side of that range. This is at any rate the impression conveyed by Wellby's map; but the country is still too little known to allow of safe conclusions being drawn.

The adverse remarks which may be made with regard to Wellby's journey, namely that his purely geographical information is too curt; that he miscalculated his equipment, his provisions giving out before the journey was half done; that he was unable to manage his people, for while two of them were without more ado left behind in the most pitiable condition, several others ran away and met with no consideration when they returned, but had, as they themselves told me, to support themselves on wild garlic and grass until, more dead than alive, they chanced to fall in with a Tibetan caravan — all these things are outweighed by the energy and boldness with which the expedition was led, and by the geographical results obtained, namely a fairly good map of the route followed, determinations of absolute altitudes, a brief description of the most inaccessible and till then quite unknown parts of Tibet, and so forth. From Wellby's description we are able to deduce the following physico-geographical features. Once fairly embarked in the gigantic latitudinal valley, down which he travelled until he struck the Tschumar river, a valley bordered on both sides by parallel mountain-ranges, he had no difficulties worth speaking about to contend against; at all events he encountered no difficulties of the kind that are occasioned by abrupt changes of absolute altitude. To his determinations of altitude we shall return lower down when I come to compare them with my own and those of other travellers. He had only to cross, just as I had in the next latitudinal valley to the north, over the flat transverse thresholds or sills which separate the different self-contained basins one from the other. He remarks with perfect justice, that it is incomparably easier to travel across Tibet from west to east or *vice versa* than from north to south. In the former case you march *between* the mountain-ranges; in the latter you have to go *over* them all. He might also have added, that it is easier to travel from west to east than from east to west, as I did in 1901, for then you do not have constant westerly storms to face. Wellby has also noticed the relatively insignificant upswellings of the Tibetan high plateau; he employs very often the term »hill» instead of the term »mountain».

When however he did come across true snow-clad mountains with dominating peaks, he does designate them, both in text and on the map, by the proper term. In this respect the relief is clearly of the same character in the part of Tibet through which he travelled as it is in the regions which I explored; that is to say, the mountainous parts that bear glaciers and perpetual snow project like islands above the otherwise more gently undulating surface of the highland »ocean».

When we consider that portion of Wellby's journey which falls within the high plateau proper, we find that the country in the west is in general more deficient in water, more desolate, and salter than it is farther east. My own observations made on the way between the Naktsong-tso and the region immediately east of Tsangerschar was pretty much the same. On the whole however Wellby's latitudinal valley would appear to be richer in grass than my latitudinal valley of 1896; this may be due to the more northerly position of the latter and its greater absolute altitude. Wellby, like all other Tibetan travellers, observed that the salt lakes are shrinking, and in the case of some of them he speaks of distinct terraces. To those who do not know northern and central Tibet from their own experience, it must sound like a paradox when they read of himself and his caravan suffering from want of water. One would expect that a mountainous country with such stupendous altitudes would be the very last to suffer from lack of water; and yet such is the case. In this respect western Tibet is more unfortunately situated than eastern Tibet, and the northern half of the highlands more than the southern. The actual high plateau is in some localities little better than a desert.

However here, as in other parts of the country, the rainy season comes during the latter half of the summer, and the farther Wellby penetrated towards the east the oftener does he speak of violent rains, frequently occurring in short, sharp squalls, followed by hail and snow. At the same time it must be observed, that not only are the rains heavier in the east, but the rainy season as a whole is more definite and so to speak more concentrated than in the west. He speaks also of continuous — in fact of almost daily — storms of great violence, at the same time telling us only exceptionally where these storms came from. Fortunately we know from our own and other travellers' experience, that they blow from the west; we know that northerly storms also occur, although these are seldomer.

Wellby likewise complains very often of the soft nature of the ground, and of its being incapable of supporting the weight of the caravan animals, and this contributed more than anything else to destroy his caravan. But with regard to this the only reflection he makes is, that a night's fall of snow, covering the ground to the depth of four inches or more, renders the surface very much worse the following day; for when the snow melts, the water penetrates into the already softened ground.

It is notewortly, that Wellby and his caravan were affected to such a degree by the intense insolation that they were forced to rest during the heat of the day and make their daily marches in two instalments. I confess I have never suffered to that extent from the hot sun even on still summer days, and moreover look upon it as double toil having to encamp and load up twice in the course of one day. But possibly the climatic conditions are in this respect more pronounced in the part of Tibet which Wellby visited than in other parts of the country.

CHAPTER XXXII.

JOURNEYS OF BONVALOT, DUTREUIL DE RHINS AND GRENARD.

I now pass to a consideration of the journeys of those travellers who have crossed the central highlands of Tibet from north to south before me, namely Bonvalot and Prince Henri d'Orléans, Littledale, and Dutreuil de Rhins and Grenard. Beginning with the first of these, I would observe that Bonvalot's journey, as a piece of exploring work, takes a very high place. He was the first who travelled right across the whole of Tibet from north to south, surpassing in this respect all his Russian predecessors. He travelled during the winter (1889—90) and so had the intense cold to contend against; but on the other hand the ground was everywhere frozen, and, according to my experience, this advantage is so great as to outweigh both the discomfort of the cold and the absence of grazing. Geographically his account of his travels is poor, Grenard's account being immensly superior, and even Wellby's is in some ways better. Bonvalot's book was written for the general public, who are not interested in geographical matters, but only care for picturesque and exciting incident. Bonvalot's altitudes are not always completely reliable; they strike me as being generally much too high, and in one or two places in northern Tibet errors of close upon 1000 m. can be proved. For the country south of Kum-köl Bonvalot's altitudes must however be accepted in the meantime. His map conveys a fairly good general idea of the orographical structure, the prevailing east-west direction of the mountain-ranges and of the broad latitudinal valleys between them standing out with especial distinctness, though he calls the latter mistakenly »plaines». With regard to the directions of two or three of the ranges one may however entertain a certain amount of doubt. His caravan started from Tscharklik on the 17th November, and on the 17th February it approached the point to the south-east of the Tengri-nor where his farther advance towards Lhasa was prevented. Thus it took him three months to traverse the Tibetan highlands. I may pass over the first part of his journey, having already touched upon it in vol. III. In what follows I will quote a few specimens of Bonvalot's manner of describing that part of Tibet which he visited, and will begin with the 12th December and the country immediately south of the Kum-köl-darja. The thermometer was then down

to — 28° (C.) and the wind was blowing fiercely from the west. During the greater part of the journey they were able to follow the trail of a Turgut pilgrim caravan, a proof that the Mongols did, at any rate at that time, make use of the direct route to Lhasa across the highlands, though I never succeeded in gaining confirmation that that route is still used. I consider it however unlikely, for the Mongols seem to prefer nowadays the more convenient detour by way of Tsajdam. Under date the 13th December Bonvalot says — »à peine sommes-nous en marche que le vent d'ouest se met à souffler. L'atmosphère est empoussiérée de suite; cela suffit à nous empêcher de voir loin et nous enlève tout sujet de distraction. Nous sommes sur un plateau ondulé s'élevant vers l'ouest, où il est borné par un chaînon sablonneux.» From this we may deduce the important conclusion, that when the wind blows hard in winter, the atmosphere may be filled with dust, and even with fine sand, and from it are formed the sand-dune areas which occur in that particular locality.

After that they travelled up beside the Pitelik-darja and plunged in amongst the parallel ranges of the Arka-tagh system. With regard to the weather on the 19th December we read — »le minimum de la nuit a été de — 28 degrés. Il est vrai que le ciel est couvert et que nous allons avoir de la neige. Elle tombe en effet, mais granuleuse, fine et pendant quelques minutes seulement,» and on the next day: »Vers cinq heures du matin il tombe un centimètre environ de neige, toujours fine et granuleuse comme du grésil. Et la température s'élève un peu, le ciel reste couvert, puis un vent sud-ouest s'élève et le soleil apparaît. Le minimum de la nuit a été de — 32 degrés.»

On more than one occasion Bonvalot speaks of volcanoes; we may take it that in so doing he was misled, as Littledale was, by the conical, volcano-like shape of certain of the mountain peaks. The occurrence of tuff, which is pretty general on the highlands of Tibet, does not unconditionally warrant the use of the term volcano. It is in this light that we are to understand the following observations under date 22nd December; the traveller was then in the »Plaine des Laves», a latitudinal valley lying immediately north of the main range of the Arka-tagh: »Après avoir dépassé quelques contreforts sablonneux, nous sommes dans une grande vallée s'étendant du nord-ouest au sud-est. Au sable parsemé de touffes d'herbes succèdent des surfaces nues et pierreuses qui semblent avoir été lavées par des eaux torrentueuses. Soudain à droite, à l'ouest, là ou la chaîne que nous avons devant nous paraît s'unir à celle que nous venons de quitter, se dresse comme le sosie du Stromboli tel que je l'aperçus pour la première fois, en cinglant vers la Sicile. C'est une véritable évocation. Baissant les yeux, je vois que le lit des ravins que nous traversons est noirâtre et semé de laves, et nous campons dans la »Plaine des Laves». Juste à l'ouest, le volcan laisse tomber son long manteau à traîne. Nous le baptisons instantanément du nom de Reclus, le plus grand des géographes français, à qui cette découverte fera plaisir. A l'est, au milieu de pics blancs, domine un géant de plus de 7000 mètres, que nous appelons du nom de Ferrier.» In the geological appendix we find the two following diagnoses of rock specimens taken at this camp: »Roche amygdaloïde avec grains de quartz et enduit ferrugineux,» and »Roche amygdaloïde avec grains de quartz dans les cavités.»

December 23rd: »A nos pieds, encore des scories, des laves, un sol noirâtre. La montagne s'ouvre largement pour nous recevoir, et se resserre à mesure qu'on avance. La route est bonne pour les chameaux, molle, poussiéreuse, semée de miettes de schiste.» Speaking of the next parallel chain, which likewise belonged to the Arka-tagh system, he says: »Sortis de la goulette, ayant franchi encore une chaîne, celle de Niaz, nous revoilà dans une vallée analogue à celle 'des Laves', mais moins longue, moins large, et s'étendant surtout vers l'est. Des lacs, qui sont parfois des dépôts de sel, paraissent gelés. Ce sont encore des lits desséchés de torrents, des collines nues, des orongos qui errent; toutefois la neige est arrêtée dans quelques crevasses. C'est la seule modification que subisse le paysage, il ne varie guère dans cette région. Et comme le ciel est brumeux, notre horizon est borné.» To the two vast mountain-ranges, which he names on his map Mts Kouen-Lun and Mts de Niatz, Bonvalot has given a quite erroneous longitudinal direction; probably this is due to the fact that the atmosphere was generally not clear. According to him these two ranges stretch from north-west to south-east; whereas in actual fact they extend from west to east, and this is the direction that Dr. Hassenstein has given to them on my general map in *Petermann's Mitteilungen*, on which the northern part of Bonvalot's itinerary is entered. Although the »Mts Kouen-Lun» are indicated as the second biggest range that Bonvalot encountered in the course of his journey across Tibet, the useful figures showing their altitude are here conspicuous by their absence.

On the 25th December we read: »La neige tombe. Toujours des petits lacs du sel, des collines sablonneuses. Une passe succède à une autre passe. Lorsque le ciel est clair, on voit à l'infini des montagnes, des montagnes entremêlées de pics, de glace et de neige. La neige tombe presque chaque jour, mais en petite quantité; le vent souffle du sud-ouest et nous perdons tout juste. Le 29 décembre, le vent est d'ouest et nous ne sommes pas mieux, car nous allons droit au sud à travers une plaine nue. Nous campons au milieu des laves, au pied d'un volcan auquel nous donnons le nom de Ruysbrock ou Rubruquis.»

On Dec. 30th: »Au nord-ouest, un volcan se dessine nettement, dans une bonne pose, bien éclairé, au souhait d'un photographe. Il laisse pendre une belle chape bien plissée, surmontée d'un col d'hermine blanche, que la neige a laissé là. Pendant quatre heures nous trouvons des laves. Les plus grosses sont les plus éloignées du volcan, auprès duquel sont accumulées les poussiéres et les miettes. Tout d'abord notre route est agréable. Elle suit un étroit ravin bien abrité où il fait chaud. Mais cela ne peut pas durer. Nous arrivons dans une steppe, et nous sommes accueillis par un vent d'ouest glacial. Avant que l'ouragan soit à son paroxysme de fureur, j'ai le temps d'apercevoir à l'ouest une grande chaîne avec des pics blancs, à 50 ou 60 verstes de la route.»

Bonvalot describes in the following graphic and poetic language the results of the wind erosion and denudation, facts which he could not help observing: »La tempête démolit les collines érodées, et les barkhanes des bas-fonds. Nous passons près de masses faites de neige et de glace, que le sable recouvre. Les lois de la pesanteur s'exercent partout; en bas des pentes, ce sont comme des grains de millet; plus haut, une poussière qui forme des vagues que la tempête enlève et qu'elle

lance dans les airs ou bien qu'elle chasse à ras du sol en forme de rayons de banderoles qui se perdent au loin contre les talus, et sans cesse ces banderoles passent et repassent entre les jambes des chevaux. Puis ce sont des paquets qui nous aveuglent complètement, ou bien c'est une pluie de petites pierres qui crépitent sur nos vêtements ainsi qu'une grêle. Tout cela est vraiment fantastique, et c'est à se demander si la terre n'est pas en démence. Sommes-nous tout en haut de la planète, dans ces déserts jamais franchis, où elle cache ses ateliers et ses laboratoires? Est-ce ici qu'elle triture la matière avec rage? L'ouvrier ne veut peut-être pas qu'on le voie à l'œuvre, et il nous jette aux yeux cette poussière. Quel curieux pays! quel étonnant spectacle que ces monts de sable se glissant sur la glace! Et quel maudit vent d'ouest!» It is evident, that the power of these westerly gales in rending the solid material from the mountain-sides and from the valleys, and in transporting it farther east, made a deep impression upon the writer of the passage just quoted. From it we obtain also evidence that this transportation of material takes place on a far greater scale and in a far higher degree in winter than at any other season of the year. Bonvalot often speaks of the atmosphere being charged with dust. I for my part found it almost always bright in Tibet, and when it was thick, the opacity was caused by moisture and cloud. I have also seen reason to conclude that the disintegrated material which fills up the valleys and older depressions *in situ* is retained in the summer by the rainfall and in winter by the moisture of the ground, which causes it to freeze into a solid mass. But on the other hand there exist regions which in virtue of their relief are in a high degree proof against the retentiveness of moisture, that is to say regions in which the moisture runs away, and the surface consequently dries quicker. This holds of course with especial force wherever the surface is convex; it is from such localities that the loose material is carried away by the wind. And in this circumstance we find one of the explanations of the great levelness of the plateau country.

On the 1st January 1890 Bonvalot again speaks of volcanic phenomena: — »Nous sortons de la vallée sablonneuse pour camper sur des collines, à proximité de la glace et à l'abri du vent d'ouest. Des laves jonchent le sol, qui a la couleur d'une cendre noirâtre. En cherchant d'où viennent ces laves, nous apercevons aux environs beaucoup de cônes tronqués.»

On 5th January Bonvalot says, not without reason: »Je n'ose plus décrire notre route. Elle est toujours la même, faite de montées et de descentes. Sa monotonie doit être insupportable à quelques-uns de nos hommes. Une chose fait toujours partie de la route, c'est le vent d'ouest. Après les nuits calmes, il souffle régulièrement vers dix heures du matin. Aujourd'hui il est glacial comme d'habitude. Nous traversons un plateau, avec des creux et des reliefs, bien entendu, où se voient quelques touffes d'herbe, du sable, des laves et de nombreuses trace de yaks, de koulanes et d'orongos . . . Les rebords du lac du Binocle sont couverts de blocs de lave. Le niveau de l'eau a été plus élevé. Il a baissé peu à peu; on voit sur les berges six cercles enveloppant le lac et indiquant les étages successifs. Nous n'en sommes pas sûrs, mais nous croyons que dans ce lac jaillissent des sources chaudes, à peu près au centre. Le 6 janvier, notre thermomètre marque — 40 degrés, température à laquelle le mercure gèle. Toujours une brise ouest. Au nord-ouest, la bouche d'un cratère qui aura vomi les laves qui nous entourent.»

With regard to the salt lake of Montcalm he makes the following remarks: »Il se dessèche, car nous traversons un de ses anciens golfes où il a déposé par places plus d'un pied de sel.» Immediately south-east of the lake they came across »une large rivière gelée», which they suspected to be a head-feeder of the Yellow River. On the 14th January he speaks of ice-capped mountain-peaks of at least 8000 m. high, clearly an exaggerated estimate. The following passage is especially interesting, for it evidently refers to the great range which I crossed over immediately north of our headquarters at Camp XLIV, that range being probably the continuation of the Tang-la. »Le 15 nous franchissons la passe, d'environ 6000 mètres, en suivant une pente douce. A l'ouest, nous voyons descendre des glaciers vers une large vallée que nos suivrons et où la glace sera notre chemin. Des pics blancs se perdent dans la brume; nous estimons leur altitude à 8000 mètres au moins. Dans toute cette région, les petits lacs, les étangs sont nombreux. Les collines de terre meuble portent la marque de la fonte des neiges et du séjour des eaux: elles ont cette 'frisure' et cette bouillie spéciales qu'on observe à la surface du sol où la neige a fondu lentement et d'où l'eau s'est écoulée par gouttes comme d'un éponge qui sèche. Tous les bas-fonds ont recueilli cette eau, ainsi que le témoigne la glace.» To this vast range Bonvalot gave the name of Mts Dupleix, and it is there that he erroneously assumes that one of the sources of the Jang-tse-kiang is situated. It seems to me extremely improbable that the pass by which he crossed over the range can have an altitude of 6000 m.

The next observation that I quote is exceedingly strange and incomprehensible: »Le 18 janvier, nous voyons des singes traverser la rivière ('Rivière des Singes') sur la glace et se jouer sur les rochers des berges. Il nous est complètement impossible d'en tuer un seul. Ce singe est de petite taille, son pelage est roux, sa queue imperceptible, sa tête petite. Cette découverte nous égaye tous, elle excite l'ardeur des chasseurs.» That apes do exist in western China is indeed known; Kosloff came across them during his latest journey; but we have never before had reports of apes on the high plateau of Tibet, especially at a time when the thermometer is down to —40° C., as it was on that particular day. Perhaps what Bonvalot saw were nothing more than marmots out for a little run in the open.

Immediately south of this river Bonvalot observed the same phenomenon which I have described as occurring at Temirlik and at Mus-kol in Pamir, namely the formation which I have called by analogy »ice volcanoes». »Nous approchons de ces pointes blanches: ce sont des cônes de glace ayant 6 à 7 mètres de diamètre, hauts comme un homme et parsemés, à la surface d'un véritable cristal, de quelques-uns des graviers de la plaine. Ces blocs sont fendus perpendiculairement comme certains fruits trop mûrs. Nous sommes devant des geisers gelés; ils se sont couverts de cette calotte solide le jour où leur force de jaillissement n'a pu lutter contre les gelées.» His explanation is of course incorrect: these ice elevations are formed by springs that gush up out of the ground, the water from which freezes in successive superimposed layers until these reach a certain height, and this depends in the first place upon the upward force of the spring and in the second upon how far the winter is advanced. If the »crater» becomes stopped up by the ice, the water seeks an escape at another spot, and that again imposes a limit upon the height of the ice-cone.

Bonvalot forded the Satschu-tsangpo. This river is identical with that to which he gives on his map the name of »Gde. Rivière (gelée)»; it is represented quite correctly as flowing towards the south-west. But the text, unfortunately, affords no information of value with regard to this river, nor do we learn even approximately how much water was flowing underneath its covering of ice.

About the salt lake of Burben-tso we are told: »Le Bourbentso est une vaste saline enveloppant un reste de lac, si l'on conclut de ce qu'on voit sur les rives. Au bas de la terrasse qui fut peut-être autrefois la berge où l'eau venait mourir, nous trouvons alignés les tas que de nombreux chameaux ont laissés là.» Here again, then, we have an instance of a lake that is drying up. The camel tracks along the shore were those of a caravan of Turguts.

Bonvalot describes in the following words his impression of the Tengri-nor and the mountain-range on its southern shore. »A nos pieds scintille un beau miroir d'argent, arrondi et prenant la forme ovale entre des falaises, à l'ouest, d'où descendent des promontoires qui découpent des golfes. Au sud-ouest, le lac tourne une colline et s'étend plus loin. Cette colline fait-elle partie d'une île ou d'une presqu'île? Nous ne pouvons le dire. Le Ningling Tanla attire plus longtemps nos regards. Cette chaîne développe devant nous son arête poudrée de neige et nous barre parfaitement l'horizon. On est surpris de la régularité — de l'altitude presque égale à l'œil — de cette suite de cimes surmontant des contreforts qui s'abaissent vers le lac, bien alignés comme le pourraient être les tentes d'une armée . . . A mesure qu'on avance vers le sud, le lac semble s'élargir et grandir aussi dans la direction du sud-ouest, et, comme la brume nous empêche de voir sa fin, il prend l'immensité d'une mer sans rivage.»

From the Tengri-nor the journey was continued *viâ* Batang to Tonking.*

Bonvalot describes in graphic terms the extraordinary uniformity of the Tibetan plateau, the never-ending succession of relatively low mountain-ranges that have to be crossed over, and the broad latitudinal valleys, with their dried up salt lakes, that intervene between them. From his description we get the impression that the amount of snow-fall in winter is not altogether so unimportant; the snow is dry and fine-grained, and the wind drives it like flour along the ground. Bonvalot found at any rate more snow on the central Tibetan plateau than I found in western Tibet. Westerly winds predominate as at other seasons of the year and from his description they are often very violent. On the other hand he records that the nights were almost always still, which agrees with my own experience. It is in the winter that the transporting power of the wind is most active.

I will now proceed to give some extracts from Grenard's account of the important journey which he and Dutreuil de Rhins carried out in the years 1890—95. In 1892 he travelled from Kerija *viâ* Polu, Kerija-kotel (5550 m.), the Jäschil-köl, the Sumdschi-tso, and the Panggong-tso to Leh, and returned over the Kara-korum pass. After leaving Polu they travelled in part over the same ground as Carey and Dalgleish before them. Subsequently Wellby also came into touch with their route. Grenard describes the north-west of the Tibetan high plateau as an excessively

* Gabriel Bonvalot, *De Paris au Tonkin à travers le Tibet Inconnu*, pp. 171—261.

barren and desolate country. The Jäschil-köl made an agreeable break in the monotonous scenery. »Depuis ce lac, qui est à deux journées de la source du Kéria dâria, on suit une série de longues vallées et de cirques au sol rougeâtre, resserrés entre des chaînes de montagnes dont les sommets et les flancs septentrionaux seuls, à partir de 5500 à 5600 mètres, conservent leur manteau de neige et derrière lesquels, vers le sud, se montraient les cimes des gang-ri ou glaciers, qui forment une troisième chaîne, à peu près parallèle à l'Oustoun tâgh et à l'Altyn tâgh.»

The real journey across the plateau of Tibet was begun in the autumn of 1893, the start being made from Tschertschen and the goal being the Tengri-nor, the same point at which Bonvalot was forced to turn back. Thence the journey was continued to Peking *viâ* the Koko-nor. Speaking of the sources of the Kara-muran, Grenard says: »Le 27 septembre, nous arrivâmes au bord et non loin de la source de la branche la plus importante et la plus méridionale du Kara mouren. Les origines de cette rivière étaient dès lors complètement reconnues. Sa vallée, haute de 5200 mètres, large de trois kilomètres, au fond uni comme un plancher, est, ainsi que les autres vallées de l'Arka tâgh, de nature schisteuse, absolument aride et déserte; pas une touffe d'herbe, pas une trace d'animal, pas un vol d'oiseau, rien qu'un peu d'eau qui court, agile et claire, sur les galets plats. Près de nous, à notre gauche, se dressait une masse colossale de neige et de glace, puissamment établie sur sa vaste base, élançant à 7360 mètres son pic le plus élevé. C'est le point culminant non seulement de la chaîne, mais probablement aussi de toute la région entre le Turkestan et l'Himalaya.» His impressions after crossing the Arka-tagh he describes in the following words: »Le prochain jour de marche nous conduisit au sommet d'un col de 5550 mètres sur la ligne de faîte de l'Arka-tâgh. Ce ne fut point sans quelque battement de cœur que nous plongeâmes les regards de l'autre côté; car si notre bonne fortune nous avait permis de nous frayer un passage à travers la première des chaînes qui nous séparaient du Tibet, rien ne nous garantissait, puisqu'il n'y avait jamais eu de route par là, que nous ne verrions pas se dresser au delà une barrière définitivement infranchissable. Nous fûmes rassurés en découvrant au-dessous de nous un plateau large de 25 milles, fermé au midi par une ligne de montagnes aux sommets presque régulièrement découpés en pointes, frangeant le ciel d'une dentelle blanche, mais au milieu desquelles, droit en face de nous, se dessinait nettement une passe qui semblait nous attendre. Ce soir-là nous campâmes donc de bonne humeur au pied méridional de l'Arka tâgh. Rien n'est plus caractéristique de ces pays de la Haute Asie que ce que nous apercevions de notre tente, cet immense plateau désert étendu entre deux murailles neigeuses. Le sol, qui, vu d'un point élevé, paraît presque plat, est en réalité bossué de monticules et de collines, coupé de ravins généralement sans eau, creusé d'une foule de dépressions où se cachent autant de mares vaseuses, humbles satellites du grand lac d'azur infiniment tranquille, qui réflète le soleil ou les nuages et nulle autre chose. La terre est gercée par la gelée, de couleur bise, à peine relevée de loin en loin par une plague neigeuse ou par une petite tache jaunâtre d'herbe, rude et courte, et, là-bas, dominant tout, les énormes montagnes de neige, aux formes lourdes et ramassées, comme accablées sous les poids de leur solennité morne, achèvent l'impression d'ennui désolé que donne ce paysage hostile à la vie.»

And with regard to the country farther south he says: »Le 14 octobre, nous recommençâmes la traversée d'une puissante chaîne de montagnes presque égale à l'Arka tâgh. Sur ses pentes septentrionales, quelques oignons sauvages croissaient jusqu'à près de 5300 mètres d'altitude; au delà la stérilité était absolue. Le vent d'ouest, qui ne nous avait pas fait grâce une heure depuis que nous avions franchi le Zarachou davân, fut plus terrible encore pendant les deux jours que dura le passage de cette chaîne.»

Still farther south in 34° N. lat., he makes the following general reflections upon: »ces solitudes désolées et infinies, dont la tristesse ne saurait s'exprimer. Maintenant comme auparavant chaque jour on traversait de hautes vallées arides, on longeait des lacs bleus, on franchissait des cols couverts de neige, et, chaque soir, on voyait devant soi de blanches montagnes dresser leurs masses majestueuses et glacées, des vallées s'étendre, mornes et stériles, des lacs déployer leur azur immobile et s'évaporer mélancoliquement au soleil.»

On the 2nd and 3rd November he notes: »Nous traversâmes deux cols qui nous menèrent dans une vaste vallée herbeuse, se dirigeant indéfiniment vers le sud-est et s'étendant entre le versant méridional des montagnes dont nous sortions et une magnifique chaîne neigeuse dont les pics se dressaient à perte de vue, resplendissants et rangés au cordeau comme une ligne de cuirassiers au port d'armes.»

Dutreuil de Rhins's expedition travelled along the north side of the Addan-tso, Tschargut-tso, and Selling-tso, the names of which he appears to have interchanged; for he calls the first of the three Tschargad tso, the second Lac Sinueux, the third Gya ring tso. It is just possible that this last name is right, for we also find it in Bower, in the form Garing Cho. We have already seen that Bower also calls the Addan-tso Chargat Cho, but is on the other hand ignorant of the real Tschargut-tso. It is possible that by Tschargut-tso the natives — at all events, certain tribes — mean the two freshwater lakes which are connected by a short, narrow sound. About the Naktsong-tso Dutreuil de Rhins obtained no information; his route ran too far to the north. He did however hear the name, and with regard to it Grenard writes: »Nous voulions nous renseigner sur le Nag-tchang, dont parle la géographie chinoise et que Dutreuil de Rhins supposait être une ville non éloignée . . . Nous apprîmes plus tard que ce mot de Nag-tchang était le nom du pays même où nous étions, dont le chef-lieu est Sen-djadzong, au sud des montagnes.» With regard to the three lakes first mentioned I will add what Grenard writes about them: »Le 13 novembre, nous campâmes au bord d'un grand lac d'eau douce, le Tchar-gad tso, qui s'étalait dans le fond d'un cirque de montagnes neigeuses dont les pieds baignaient dans les eaux au bleu vif, continuellement grondantes. La vue en était fort belle et Dutreuil de Rhins la comparait à celle que l'on a entre la Bosphore et les Dardanelles par un beau temps d'hiver après une tombée de neige. Le lendemain et le surlendemain, nous suivîmes par un étroit sentier la côte du plus joli lac qu'on puisse imaginer, reserré, sinueux comme un serpent de saphir, chatoyant au soleil et tressaillant à la brise, exactement enchâssé entre des parois marmoréennes, se glissant dans des criques aux découpures capricieuses, contournant des promontoires curieusement et nettement taillés, se prolongeant encore par derrière les rochers qui semblaient le borner. C'eût été une promenade délicieuse si le froid n'avait été si âpre. Le 16,

nous nous retrouvâmes dans un de ces paysages désolés d'autrefois, dans une vaste vallée, couverte d'efflorescences salines, avec, au pied des grands monts blafards, un lac salé et pris par les glaces, qui s'étendait au loin, indéfiniment morne et triste. C'était le premier lac gelé que nous rencontrions, comme aussi le plus grand que nous eussions encore vu. On l'appelle Gya-ring tso, nom qu'il mérite par sa longueur exceptionnelle de cent kilomètres. C'est sur sa rive méridionale que M. Bower fut arrêté et obligé à retrousser chemin . . . Continuant notre marche, nous arrivâmes au bord même du Gya-ring tso. Il neigeait et nous étions enveloppés d'une brume épaisse à travers laquelle nous nous dirigions à la boussole. Nous nous engageâmes ainsi sur la glace du lac, mais des craquements, accompagnés d'un tremblement de la surface, nous fit revenir précipitamment sur nos pas, et après de longs tâtonnements causés par l'impossibilité de distinguer nettement, dans l'obscurité blanche qui nous entourait, l'eau gelée de la terre ferme, nous réussîmes à contourner le lac par l'est, nous franchîmes la glace d'un étang, traversâmes des collines et parvînmes au pied de la grande chaîne, dans un vallon vert où se détachaient en noir plusieurs tentes et la muraille vivante d'un gros troupeau de yaks domestiques. Ce lieu s'appelait Tag-sta pou (24 Novembre).»

It is interesting to learn that the Selling-tso (Gya-ring tso) was frozen as early as the end of November, and this in spite of the lake being salt and of its large area. It is true the salinity is not very great; but one would expect that the lakes Addan-tso and Tschargut-tso, that lie to the west of it, both perfectly fresh and both very much smaller, would freeze before it does. In the end of November they were however open, while the Selling-tso, the biggest lake that the French expedition had hitherto encountered, was also the first frozen lake they saw. The explanation must lie in the depth. The part of the Selling-tso which I sounded was extraordinarily shallow, and if the depth throughout does not exceed a few meters, the water, being so slightly saline, ought by the end of November to be so cooled right down to the bottom that it needs but one or two still days and nights for a thin crust of ice to cover the entire lake, and by the middle of January and February this ought to reach a not inconsiderable thickness. In the Tschargut-tso, in which we obtained depths of fully 48 m., a longer time will be required for the cooling of the water, and the ice will therefore form later. The same thing would appear to be true of the Addan-tso.

The map of the French expedition, notwithstanding that it marks a vast advance upon Bower's map of the same region, does not show the hydrographical interrelations of the three lakes in question. The expedition kept to their northern shores and was therefore unable to see the sounds that connect them. Grenard's sketch of the Addan-tso and the Tschargut-tso bears a very close resemblance to my map, and the isthmus between the two lakes is shown as very narrow, though not cut through by a river-arm. The western lake is represented as lying 50 m. higher than the eastern, whereas the real difference of altitude between them barely reaches 1 m. In Grenard's Lac Sinueux it is easy to recognise my Tschargut-tso with its projecting peninsulas and deeply penetrating bays. The distance between the Tschargut-tso and the Selling-tso is as nearly as possible correct, but the river Jagjurapga, the stream which carries the water from the former into the latter, is wanting.

All the same the map shows the gap in the mountains through which this river flows. Hence it is positively wrong to make the Tschargut-tso lie 30 m. higher than the Selling-tso. On the northern shore of the last-named, which is everywhere flat, the map gives quite close to the lake three different alitudes, namely 4462, 4430, and 4450 m. respectively. I propose, in a special chapter, to analyse the altitudinal observations which we possess of the Tibetan highlands. Here I will only mention that there exists a difference of not less than 300 m. between Bower's and Grenard's altitudinal observations for the Selling-tso; whereas the former makes the lake lie at 4732 m., the latter puts it at 4430 m. According to Littledale the altitude is 4720 m. My own observations resulted in an altitude of 4611 m. for the Selling-tso. By taking the mean of the three values first quoted we obtain 4627 m., and this approaches within 16 m. of the altitude which Dr. Ekholm has calculated from the data that I obtained.

The French map represents three rivers as entering the Selling-tso, a »torrent gelé», a »Sa-tchou, rivière gelée», and an »eau abondante». According to the map, the travellers crossed the Satschu-tsangpo rather more than 20 km. from its mouth, and we are told that the river was frozen in the end of November.

In the third volume descriptive of the expedition Grenard has in an excellent way gathered up the general geographical characteristics. I will take the liberty of quoting one or two further passages from it for the purpose of illustrating the features which we are just now considering:

»Entre le méridien du lac Pang-kong et celui de Nag-tchou les chaînes des montagnes sont séparées par de hautes vallées stériles que les Tibétains appellent *t'ang*, semblables aux Pamirs. Ce sont de véritables plaines d'une altitude absolue considérable. Il est à peine nécessaire de dire que ces plaines ne s'allongent point sans interruption ainsi que des plates bandes entre les chaînes latitudinales; l'espace qui sépare celles-ci est en réalité sans cesse coupé par les chaînes transversales et bosselé par les contreforts des unes et des autres. Néanmoins il subsiste une notable étendue de plaines dispersées, presque toutes fort vastes, plus vastes en général que les Pamirs, et toutes occupées dans leur parties les plus basses par un ou plusieurs lacs. Le terrain y a si peu de pente, ou y a des pentes si mal déterminées qu'il se transforme l'été en marécage et n'est solide que lorsqu'il est gelé. C'est justement le caractère de la *toundra* sibérienne. Lorsque nous prononçons le mot de marécage, nous évoquons volontiers de vastes étendues toutes verdissantes d'herbes fraîches et plantureuses. Dans ces contrées du haut Tibet ce sont au contraire les vallées le plus stériles qui sont les plus marécageuses. Au sud des monts Dutreuil de Rhins le. caractère marécageux diminue; les vallées ont plus de pente et plus de végétation qu'au nord, en même temps qu'elles sont moins étendues en général.»

Grenard's chapter entitled »Hydrographie du Haut Plateau Tibétain» is both interesting and instructive for our present purpose. He regards the region between the Arka-tagh and the valleys of the Indus and the Brahmaputra as being entirely »soumise au régime lacustre». During the course of their journey the French expedition touched no fewer than 45 lakes, most of which were unknown. The time has not yet come for an estimation of the number of lakes on the Tibetan plateau, the portions of it still unknown are as yet too great; but even now the number

which have been discovered amounts, I am sure, to something like 200. If to these we add the pools and smaller sheets of water, the number will of course easily run up to several thousands.

On the highest parts of the Tibetan plateau the French expedition in 1893 mapped 17 lakes between the Arka-tagh and the Lha-ri Mé-long, all of them of medium dimensions. Nor did they discover any lakes of large size between the sources of the Kerija-darja and the Panggong-ts'o. The largest was the Ma-ouang ts'o, with an area of about 700 sq. km. Grenard estimates the area of Lake Montcalm at less than 600 sq. km. and the A-rou ts'o at less than 500 sq. km. The Lac des Hemiones is computed to have an area of 600 sq. km. Grenard considers it possible that this lake may be made up of two separate basins. The Horpa ts'o covers an area of 300 sq. km. All the rest are each less than 200 sq. km. But large lakes occur south of the range of Mé-long gang-ri. The Tchar-gad ts'o (= Addan-tso) reaches 400 sq. km. The surface of the Gya-ring ts'o (= Selling-tso), which according to Grenard is as long as the Koko-nor, though narrower, he estimates at 1300 sq. km., while the Nam ts'o he computes at 1800 sq. km.

»Les eaux des lacs que nous avons vues sont salées et quelquefois chargées de soufre comme celle de l'Atchyk koul sur le plateau de Gougourtlouk, ou d'ammoniac comme celles du lac sur le bord duquel nous avons campé le 1er novembre 1893. Nous n'avons relevé que deux exceptions: le Tchar-gad ts'o et le Nam ts'o dont les eaux sont douces, au moins potables, car nous en avons bu. Nous nous sommes même servi de l'eau du Nam ts'o pendant cinq semaines.»

Grenard states that the expedition was unable to measure the depth of any of the lakes they saw, but he assumes that they are not very deep; and he truly observes: »Le lac Pang kong, dont les eaux ont moins de 45 mètres d'épaisseur ne compte vraisemblablement pas parmi les moins profonds.»

I myself obtained a maximum depth of 48 m. in the Panggong-tso, and this value, which I also sounded in two other lakes, was the greatest I found throughout the whole of Tibet. With regard to depths Grenard distinguishes with perfect correctness between two different groups of lakes. »Les lacs de montagne aux rebords accentués et découpés, tels que le Pang kong, le Ko-né ts'o, le Nam ts'o, le Pam ts'o, le Tchar-gad ts'o, le lac Sinueux, sont plus profonds que les lacs de plaine aux limites indécises, ceints de marécages, comme le Boul-ts'o, le Gya-ring ts'o, le Tag-tsa ts'o, le Soum-dji ts'o. Tandis que le Gya-ring ts'o gèle au commencement de novembre, les eaux du lac voisin, le Tchar-gad, sont libres à la même époque, et celles du Nam-ts'o ne sont prises par les glaces que dans la seconde moitié de décembre.» Otherwise Grenard considers that the greater part of the lakes of Tibet are »mixtes»: *i. e.* their shores are partly rocky, partly flat and marshy. Nowhere on the north of the high plateau did they find lakes that were entirely surrounded by mountains. These exist principally in the southern regions, where the surface relief is more accentuated. According to Grenard's observations all these lakes are shrinking in consequence of the heavy evaporation and the small compensation that they receive from clouds and inflowing streams.

»En certains endroits on voit la trace très nette de la baisse des eaux. Ainsi le petit lac Tâchlyk koul, à l'ouest, est ceint de plusieurs gradins superposés,

aujourd'hui à sec, qui ont été façonnés et polis par les eaux durant des siècles et affectent une régularité qu'on croirait artificielle. Sur les parois du lac Sinueux on aperçoit la marque de l'ancien niveau à près d'un mètre au-dessus du niveau actuel. Nous avons noté deux lacs récemment desséchés, dont le fond peut avoir encore un peu d'eau au mois de juillet. Enfin entre l'Altyn tâgh et l'Oustoun tâgh, particulièrement sur notre route entre le Kéria daria et l'Angid koul, et en divers points des plateaux du nord, nous avons observé un grand nombre de cuvettes de faibles dimensions, où les eaux ont évidemment séjourné autrefois, à une époque assez reculée.»

Generally speaking, all this agrees on the whole with my own observations, except that we must not restrict the desiccated lakes to the area indicated by Grenard: the region in which they occur with the greatest frequency would appear to be in the neighbourhood of the highest mountains.

With regard to the rivers of the Tibetan plateau Grenard says that the longest have a course of 50 to 60 km. Amongst them he names the Jäschil-su in the west and »la rivière de l'Antilope» in the east. In the region to the north of the Dutreuil de Rhins mountain-range he speaks of a river which was 15 m. broad and 3 feet deep, though it was only a sound connecting two lakes. On the south side of the same range they passed a river-bed, which was 320 m. broad, but perfectly dry, and which terminated in a lake that was likewise dried up. South of lat. 32° 20' running streams became more numerous. »La rivière des Lièvres qui se jette dans le lac des Perdrix, roule à la fin d'octobre une eau rapide, profonde de deux pieds. Sa vallée est d'ailleurs exceptionnellement encaissée. Le torrent tributaire du lac ammoniaque est aussi assez abondant et encaissé.» South of the Lha-ri Mé-long range the rivers are bigger still. He estimates at 75 km. the length of the Gyou tchou, which empties into the Panggong-tso; while he puts the length of the Bogtsang-tsangpo at 135 km.*

But I cannot dwell longer upon Grenard's valuable and extremely useful work, beyond saying that it is absolutely indispensable for every student of the geography of Tibet; it is far superior to any other of the accounts which I have here briefly touched upon. And its own intrinsic value is in a high degree enhanced by the map which Grenard prepared and has published in an atlas of 25 sheets on the scale of 1:500,000. This again marks an incalculable advance upon even the maps prepared by the officers of the Russian General Staff. The astronomical observations were made by Dutreuil de Rhins. The mountain-ranges are shown by means of equidistant curves, which makes them stand out with sufficient distinctness, even though they are sometimes drawn only in outline. All altitudes are entered, and the depressions are shown in a clear and distinct way. The map would undoubtedly have gained in appearance had colour been used, although it can of course be dispensed with. In so far as I am in a position to check the topographical details of the map, they are very exact, and it is not difficult, even without the help of the astronomical observations, to determine where you are. Such errors — and it is of

* J. L. Dutreuil de Rhins, *Mission Scientifique dans la Haute Asie 1890—1895*. I. *Récit du Voyage;* III. *Histoire-Linguistique-Archéologie-Géographie*, by F. Grenard.

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course always impossible to avoid errors entirely — such errors as do occur are of no moment. One of these Grenard himself corrected later, namely that of uniting the Selling-tso and the smaller lake to the east of it, into *one* lake on his big general map. With great industry and labour Grenard has collected all the information that we possess with regard to the orography of Central Asia, and has embodied it on a general map on the scale of 1: 400,000 — »Carte de l'Asie Centrale dressée d'après les travaux des explorateurs modernes, les cartes chinoises, et les renseignements des indigènes.» The dominating mountain systems are depicted by means of heavy brown lines with the native names wherever such exist; otherwise European names are attached, these being nearly always explanatory. Mount Wellby is, for instance, the range which runs south of Wellby's latitudinal valley. Later on I shall have occasion to refer again to this excellent map.

Quite recently Grenard has published a very readable and able account of his journey, written for the general public.* From it I venture to quote the following succint and clear description of the physical geography of high Tibet: »Physiquement le Tibet se divise en deux parties, la région des lacs et celle des rivières, qui enveloppe la précédente de trois côtés en demi-cercle. La région des lacs, qui s'étend entre le lac Pang-kong, les sources de l'Indus, le Dam La-rkang la, les sources du Solouen et du fleuve Bleu et enfin celle des rivières du Turkestan, affecte la forme d'un fer de hache, ayant 300 kilomètres de largeur à l'emmanchure du côté du lac Pang-kong, 700 à l'autre extrémité, sur 1100 de largeur et couvrant ainsi une surface égale à celle de la France. Cette partie du Tibet étant la plus éloignée de l'Océan, les précipitations atmosphériques y sont plus rares qu'ailleurs, le climat y est d'une grande sécheresse et les eaux n'y peuvent acquérir assez de puissance pour triompher des obstacles et se façonner un chemin vers la mer. Les chaînes de montagne sont largement étalées, arrondies, mal articulées, séparées par des vallées presque plates, semblables aux Pamirs, d'une altitude absolue considérable, médiocrement inférieure à celle des sommets. Aucune pente générale n'y est suffisamment déterminée pour permettre aux eaux de s'assembler en rivières; les ruisseaux et les torrents vont s'endormir dans des lacs innombrables, éparpillés de tous côtés comme des fragments de miroir brisé. L'écoulement des eaux est si peu favorisé que le terrain est entièrement imprégné d'eau, sauf sur les côtes, gelé et solide pendant huit mois de l'année, boueux et mouvant au cœur de l'été. Aucune autre contrée au monde n'a une altitude moyenne égale sur une pareille surface. Cette altitude moyenne est supérieure à 5000 mètres, les vallées ayant de 4400 à 5300 mètres, les pics des 6000 à 7500, les cols de 5000 à 5800. La partie septentrionale de cette région est la plus élevé, les vallées n'y ont jamais moins de 4800 mètres; aussi la température est-elle fort rigoureuse . . . La végétation est à peu près nulle et le peu d'herbe qui pousse n'est jamais verte. Les pâtres tibétains n'y viennent point planter leur tente . . . La partie de la région lacustre, qui s'étend en segment d'ellipse entre le Pang-kong et le Nam-ts'o, le long de l'itinéraire de Nain Singh, plus méridionale et un peu moins élevée (4600 mètres en moyenne), est plus

* *Le Tibet; le Pays et les Habitants*, Paris (1904).

habitable . . . Terre dure et avare, qui ne donne qu'à regret un peu de pain aux hommes qui l'habitent. Auprès d'elle les plus sauvages cantons de la Suisse ressemblent à des parcs de plaisance. En quelque lieu que l'on soit, on est entouré de hauteurs que la neige ne quitte jamais, on est flagellé par des vents véhéments et aigus, exposé à des froids polaires. L'aspect de la nature est austère, monotone, accablant par l'énormité des proportions, rarement égayé par un soupçon de grâce fugitive. Le séjour en serait presque insupportable si le ciel et l'eau n'étaient clairs.»

CHAPTER XXXIII.

LITTLEDALE, CAREY, NAIN SINGH, BOWER, AND DEASY.

I will now proceed to consider the last of the three great journeys right across Tibet from north to south, namely that of Littledale and his party. Leaving Tschertschen on 12th April 1895, they reached Srinagar in the middle of November the same year, after having crossed Tibet from north to south and from east to west. As an energetic and hurried »penetration» into one of the most inaccessible and inhospitable mountainous countries on the earth this journey is a wonderful one; but it has very little to do with geographical exploration. In point of results it cannot for one moment compare with the second French expedition with which we have dealt in the preceding chapter. Had Littledale been the first who crossed Tibet from north to south, his journey would have been valuable as proving the *practicability* of such a journey; but we did already know that it is not impossible to cross the country from East Turkestan to the Tengri-nor. His address to the Royal Geographical Society of London did not contain any strikingly new facts: it gave no general view of the physical geography of the country, but only a brief account of the actual journey itself and of the minor events that happened on the road. The account conveys the impression that the sole object of the journey was the desire to reach Lhasa. The discussion which followed the paper was also more than usually barren of results; but then the address itself did not suggest any interesting topics for discussion. Still we ought to be grateful for even small contributions. Littledale's journey has at any rate the merit of having given us a fairly good map of the region traversed, a region in which he was almost everywhere the first European. True, it shows a lack of practical wisdom to have travelled from Tschertschen to the point where Wellby intersected their route a year later by precisely the same road that Dutreuil de Rhins had already used; for even though the results of the latter's journey were not then published, and consequently were unknown to Littledale, still he might quite easily have learned in Tschertschen which route the French expedition had chosen. But from the point of intersection just mentioned all the way to Goring-la in the Nin-chen-tang-la Littledale broke new ground. His map gives a good idea of the country and is much better than Bonvalot's, although it cannot for one moment be compared with Grenard's.

Littledale crossed over the Arka-tagh — like Pjevtsoff, he incorrectly calls it the Akka-tagh — by a pass which lies only a very short distance west of the pass which I chose a year later. What he says about it is this:

»The pass, though not steep, was high and long, and it cost us the lives of five or six donkeys and a couple of horses. We found ourselves at last on the Tibetan plateau, having lakes and low mountains to the south as far as could be seen, and to the north we had the high range of the Akka-tagh, with fine glaciers and snowfields . . . The Tibetan plateau proper, which probably has an average height quite 2,000 feet in excess of the Pamirs, has, in its northern part especially, a very small rainfall, and in the absence of rivers the drainage of the country finds its way into one or other of the innumerable lakes, which, having no outlet, are salt. Except in the volcanic country, the valleys are broad and open.» Mysterious volcanoes appear with too great frequency in Littledale's address, and there exist many reasons why their existence must be received with doubt, not the least being that he travelled past them too hurriedly, and he appears to have taken every conical mountain for a volcano.

»We passed through a volcanic country with little grass, and water rather scarce. Later in the summer the grass would be better, but in May there was only the previous year's growth, which had had all its nutriment weathered out of it, and our animals began to suffer severely.»

With regard to the general orographical configuration of the country Littledale justly calls attention to the slight degree in which the mountain-ranges rise above the base of the plateau: »We travelled on for some time with a dwindling stud over a succession of passes of no great height above the general run of the country, but many of them were steep.» On the other hand the following observation is only in part correct: »After we left the Akka-tagh we never saw a single continuous mountain-range till we came to the Ninchen-Tangla, south of the Tengri-Nor,» an observation which can only be based upon an illusion, for not only is it impossible to have travelled such a great distance without crossing over at least one range the eastern or western termination of which would have been out of sight, but, from the summit of a pass you often fancy you can see a breach in a range where in reality there exists only a relatively deep depression or saddle. Then we once more have the volcanoes cropping up: »We passed three very conspicuous volcanoes, which must have been considerably over 20,000 feet. They had made excellent landmarks for some time previously. Between 36° 50′ and 33° 50′ N. lat., our path lay through a very volcanic region, numerous undoubted volcanoes being visible. South of 33° 50′ I did not notice any, till three months later we passed the conspicuous volcano Tongo.» Now I had an opportunity to visit this particular volcano, and I have no hesitation in stating that it has not the very slightest connection with any form of volcanic activity; and from this we may justly adopt a sceptical attitude with regard to the other »volcanoes» of which Littledale speaks.

We read further: »June 26, lat. 33° 12′ N., and long. 88° 12′ E., was remarkable for two things: we had the first rain since leaving the Black Sea in November — and I think at this point we first came under the influence of the south-west monsoon; the skies became more cloudy as we went south, and we frequently

had small showers — and we saw the first men since Cherchen, in the middle of April.»

It must be regarded as an exceptional circumstance, that Littledale was able to cross the whole of northern Tibet in the summer without experiencing a single shower before he reached the latitude stated. Perhaps however he means a good steady rain and ignores slight passing showers, for these are not at all uncommon in northern Tibet even in early summer. With regard to the rainfall, he made the same observation that other travellers have made, including Rockhill and myself, namely that it increases from north to south, especially during that part of the year in which you are, as it were, riding to meet the rain.

After the following brief statement: »We were everlastingly crossing from one lake basin to another, but as we got south the gradient became less steep than what we had met with further north,» Littledale goes on to the equally brief statements about the Selling-tso and the Satschu-tsangpo which I have already quoted. Speaking of the Tengri-nor, he says: »We crossed a low pass, and then came in sight of the Tengri-Nor, locally known by the name of Nam-tso = Great Sky Lake, vividly blue, stretching away far to the east, with here and there a small island. A number of promontories jutted into the lake from the north, while on the south it was fringed by the magnificent range of the Ninchen-Tangla; — a succession of snow-clad peaks and glaciers, partially hidden in clouds and vapour, which added to their size and grandeur, while above all towered with cliffs of appalling steepness the great peak of Charemaru, 24,153 feet.»

In the following passage he does give in brief and graphic terms a little résumé of the physical geography, his observations with regard to the dried up lakes being especially interesting.

»Almost without exception every lake in this country has greatly decreased in size, and the process is still going on; there are lines of gravel, sometimes six or eight, one above the other, showing the height the water once had been, and marks high up along the rocks, as much as 200 feet above the present water-level, were occasionally found. On the sides of the hills surrounding the Lakor Tso the marks were peculiarly distinct. In past times the size of the lakes must have been vastly larger than at the present day. I noticed in several instances that when lakes had divided into several smaller ones by the subsidence of the water, the top of the ridge of land separating them was usually about 40 yards wide, perfectly level, and having the appearance of an artificially made dam or railway embankment. There was capital grazing in most places, the grass much resembling the bunch grass of the Western States. The country ahead promised to be easy travelling, and so it proved to be — valleys joining on to each other with gentle passes right up to the Ladak frontier, a great contrast to the country south of Cherchen, which resembles a ploughed field on a gigantic scale; and as our course unfortunately did not lie up a furrow, we had to cross from ridge to ridge.»[1]

Carey's description of the journey which he and Dalgleish took, in the year 1885—86, through the same parts of Tibet as those traversed by the three north-

[1] *A Journey across Tibet; from North to South, and West to Ladak*, by St. George R. Littledale, in *Geographical Journal*, Vol. VII (May 1896), pp. 453 ff.

to-south journeys that I have dwelt upon above does not tell us very much that is new about the character of the general geography of the country. But his map, although destitute of detail, is nevertheless valuable. About the Ajagh-kum-köl and its environs he gives us the following information: —

»We crossed the Chiman Tagh range of mountains by the Amban Achkan Pass. The view to the south from the top of the pass showed us a wide plain with a good deal of water about it, and another formidable range of snowy mountains beyond in the distance. A big lake called the Chong Kum Kul stretched away to the west farther than we could see, and a large river flowed down the plain from east to west, emptying itself into the lake. On descending we found that the plain was a huge morass which could not possibly be crossed by our baggage-animals, and we therefore had to follow the right bank of the river for some forty miles to the east before a place for crossing could be found. The Kalmaks, who usually leave Abdal in May and return from Lhasa in February or March, are able to cross this plain when homeward-bound in the winter, but are obliged in summer to make a circuit to avoid the morass.«

Interest attaches further to his mapping of the Bokalik valley and its stream, which he calls »a very considerable stream». It was June when he was travelling through this region, and he says of the weather that »hail or snow fell almost every day.«*

We have also five great latitudinal journeys across the Tibetan highlands, three from west to east, namely those by Nain Singh, Bower, and Wellby, and two from east to west, namely Littledale's and my own. To three of these I have already alluded above, namely my own, Wellby's, and Littledale's, and I have, further, on several occasions compared my own observations with those made by Nain Singh and Littledale. All that now remains therefore is to recall some of the physico-geographical features which Trotter succeded in deducing from the itinerary and observations of the famous and able pundit, whose results far surpass in point of value those of many European travellers. In the year 1873 Nain Singh travelled from Leh to India *via* the Tengri-nor and Lhasa. The most interesting part of his journey is that which led to his discovery of the great central Tibetan lacustrine region south-west of the Tschargut-tso. From the purely scientific point of view his journey can only be looked upon as a pioneer effort, but in that character it affords clear and distinct indications of the plentiful harvest which a modern explorer would be able to reap in those regions. Of the road from Noh to Thok Daurákpa he gives the following general descriptions: — »From Noh the Pundit toiled on for many weary marches over this Tibetan plateau; his road lay eastward along a wide, open, grassy valley, varying in width from 6 to 10 miles, bounded on the north and south by low grasscovered hills, through which occasional openings gave a view of extensive plains stretching away as far as the eye could reach. Beyond the hills sometimes appeared snow-capped mountains, while an occasional shepherd's tent in the foreground, and the frequent appearance of large herds of wild asses, antelope, and gigantic wild sheep, helped to relieve the monotony of the journey. In almost every day's

* *A Journey round Chinese Turkistan and along the Northern Frontier of Tibet*, by A. D. Carey, in *Proc. of the Royal Geographical Society*, vol. IX (1887) pp. 731 ff.

march large sheets of water were passed, generally salt, but occasionally fed by fresh-water springs. At the latter the Pundit and his companions would fill their water-skins, as they rarely knew from day to day whether or no they would be able to obtain a fresh supply on the road . . . For the first thirty marches from Noh the heights of the camping-grounds varied between 13,700 and 15,000 feet, and for the rest of the journey to Namcho the ground was somewhat higher, but there was no considerable rise or fall throughout this portion of the Pundit's route. The large, flat, open valleys traversed by the Pundit, locally termed *Sangs*, appear to be much of the same nature as the *Pámirs* between Eastern and Western Turkistán and the *Jilgas* of Northern Ladákh. These sangs of Tibet, however, would seem to have more of plain and less of precipitous mountains than either the Pámirs or the Jilgas.»

Nain Singh gives the following information about two small salt lakes east of the Tso-ngombo and south of the valley of the Tsanger-schar down which I travelled: »The Pundit passed *en route* the salt marshes of Khai Cháká and Dakdong Cháká, from which the people of the surrounding country collect large quantities of salt, which they carry for sale to Ladákh. He states that the salt forms a crust, lying like a sheet of ice on the surface of the mud. The salt-seekers sink through this crust up to their loins in mud and water and remove the salt, which they subsequently wash, clean and dry in the sun.»

»For ten marches from Chabuk Zinga to Hissik Cháká the country was uninhabited; the road lay over a plain similar to what had already been traversed between Noh and Chabuk.»

»From Kezing eastward for a distance of 80 miles, up to Thok Daurákpa, the country was uninhabited when the Pundit passed through it; but it is occupied by the Khámpas of Garché at certain seasons of the year. There is capital grazing, and an abundant supply of water and fuel (argols) throughout. The road lies the whole way in one of the broad open *sangs* before described, lying between ranges of hills running east and west. South of the Tashi Bhup Cho, the southern range runs off in a south-east direction, rising rapidly in height, and forming a massive group of snow-covered peaks, known as the Shyalchi Káng Jáng, the positions of several of which were fixed by the Pundit, although at a distance of from 30 to 40 miles south of his road. From this snowy group flows northwards a very considerable stream, the Shyal-chu, which was crossed by the Pundit in three separate branches, nowhere more than a foot in depth, but said to be passable only with very great difficulty during the floods caused by the melting of the snow in the summer months.»

With respect to the road from Thok to Lhasa we read *inter alia:* »His route lay over precisely the same kind of country that he had previously traversed; it crossed several streams, all flowing to the north . . . Although the plain he was now traversing was more than 16,000 feet above the level of the sea, the Pundit does not appear to have suffered very much from the great elevation; the weather was mild, and he speaks of the whole of the journey over the plains of Tibet as a delightful pleasure excursion, when compared with his experiences over the Kara-Korum and other passes on the road from Leh to Yárkand.»

»In the 8th march from Thok Daurákpa the Pundit encountered a lofty range of mountains which was crossed by a high but easy pass called Kilong, 18,170 feet above sea-level. This range runs southward and culminates in some enormous peaks known by the name of Tárgot Lhá, from which extends eastward a snowy range, numerous peaks in which were fixed by the Pundit, along a length of 180 miles, up to where the range terminates in a mass of peaks called Gyákharma, which also lie to the south of and very near the Pundit's road. The highest of these Gyákharma peaks was ascertained by measurement to be 22,800 feet above sea-level . . . This range is probably not the watershed between the basin of the Brahmapútra and the lake country of Hor, for the Pundit was informed that to the south of the range, running parallel to it, is a large river, the Dumphu, or Hota Sangpo, which ultimately changes its course and flows northwards into the Kyáring Lake.«

»The Pundit is of opinion that the Dángrá Yum Cho, and the smaller lake of Táng Jung to the north, were formerly connected together in one vast expanse of water. The Dángrá Lake is even now so large, and the wind sometimes raises such violent waves, that the Pundit compares it to the ocean.«

»Thus far on his journey the Pundit states that a cart might be driven all the way from Noh without any repairs being made to the road; but in crossing the range which bounds on the east the Pembo country, the path was steep and difficult. There is an alternative road, however, lying to the north, by which it is said a cart (supposing there to be such a thing in the country) might easily travel from Thok Daurákpa to the Namcho Lake without meeting a single obstacle *en route*. The country to the east of the Pembo district is of a precisely similar nature to what the Pundit had already passed through on the west. It is inhabited as far as the Namcho Lake by pastoral Changpa nomads, who live mostly on the produce of their flocks and herds.«

The following condensation by Trotter, based however upon the Pundit's itinerary, is especially interesting, and proves the perfect correctness of the conception which the Pundit formed thirty years ago of the general character of the Tibetan highlands. »The height of the plateau traversed appears to vary but little between 15,000 and 16,000 feet above the sea-level. The plain is, as a rule, confined between mountains which run parallel to the direction of the road, but a few transverse ridges of considerable elevation are crossed *en route*. The drainage all tends to the north, the streams from the snowy range to the south finding their way into numerous large lakes, which either lie in the *sangs* traversed by the Pundit, or are enclosed in similar *sangs* to the north. These lakes are the characteristic features of the country, and the Pundit may well be proud of the discovery and survey of such a numerous and extensive system. Of the whole series, extending from Noh to Lhása, the only one that has hitherto been known to geographers is the Nam Cho or Tengri Nur of the extreme east, which, although its position with regard to Lhása was approximately known, and was marked on the old Chinese maps, yet it is only within the last few years that its position and extent have been determined with anything like accuracy; this was done by another Pundit, a pupil of the veteran explorer whose discoveries I am now relating.

The largest of these newly-discovered lakes, the Dángrá Jum Cho, is about 45 miles in length, by 25 in breadth at its widest part; another large lake, the

Kyáring Cho, is 40 miles in length, and from 8 to 12 across. The waters of the former are slightly brackish, but those of the Kyáring Cho, and nearly all the lakes to the east, are beautifully fresh, and, as well as the streams which feed them from the south, contain abundance of fish, and are covered by myriads of wild-fowl. Unfortunately for themselves, the Changpas have a prejudice against killing and eating either fish or fowl.

On the occasion of the former exploration of the Namcho Lake it was frozen over, and although the Pundit made the complete circuit of the lake, he was unable to discover any stream flowing from it. On the present occasion, however, our Pundit, having visited it in the autumn, before its waters were frozen, distinctly traced a stream issuing from its north-western extremity, and flowing in a westerly direction. Although, at the time he saw it, the stream was not more than a few feet in width, the watercourse was broad and deep, and in the summer months must give exit to a large river.»*

Considering the time at which this journey was made, its results are especially important; the interior of Tibet between Ladak and the Tengri-nor was at that time perfectly unknown. Now however we command more plentiful materials for forming an opinion as to the general geography of the country; but the observations which have been made since Nain Singh's time have only confirmed the accuracy of his observations. The passages which I have cited above from his journey require no further comment. It is significant that he found the climate relatively mild; this may in no slight degree be accounted for by the fact that the whole way he had the constant wind at his back. He states that the rivers which he crossed in the interior of Tibet flowed in general towards the north, a striking indication of the existence of a vast swelling south of his route; probably this swelling may be regarded as a definitive water-parting between the valley of the Tsangpo and Central Tibet. His statement that a river issues out of the Tengri-nor and flows westwards is probably incorrect. Along the northern shore of that lake he followed the same road which in 1872 had been taken by one of his predecessors. As appears from the passage quoted above, this Pundit found the Tengri-nor frozen. About this lake he gives the following information: — »Though the water of the lake is so salt as to be unfit for drinking, it is nevertheless quite frozen over in November, the lake being about 15,200 feet above the sea; when the explorer saw it the surface looked as if it was made of glass; it is said to remain in that state till May, when the ice breaks up with great noise. The lake contains fish, and quantities of small shells are found on the banks.» In his memorandum to the Pundit's report Montgomerie adds the following note: »The great lake, which at a distance was called the Tengri Núr, was found on nearer approach to be called Namcho or Sky-lake from the great altitude at which it is. It proved to be a splendid sheet of water about fifty miles in length, by from sixteen to twenty-five miles in breadth. It receives the water of two considerable rivers, and several minor streams, but has no exit; the water is decidedly

* *Account of the Pundit's Journey in Great Tibet from Leh in Ladákh to Lhása, and of his Return to India viâ Assam*, by Captain H. Trotter, in *Journal of the Royal Geographical Society*, vol. XLVII (1877).

bitter, but, owing to the intense cold, it freezes readily, and at the time the explorer saw it, it was one continuous sheet of ice.»

It is surprising to find the Pundit speaking of the water as salt, especially as, as stated above, Grenard says it is quite fresh. The mention of the existence in it of fish and molluscs proves that it must as a fact be fresh; nor is it conceivable that such an extensive lake would become frost-bound as early as November unless it were as a fact salt. The cause of the water's being fresh is a problem which future investigation must solve, because in a self-contained basin such as that salt water is the very thing that one would expect to find. The Tengri-nor is too little known to allow of guesses being made. About the small lake of Bul Cho, six miles long by five miles broad, the Pundit gives the following information: »A kind of borax is found beside the lake and in it: it is called »Bul», and hence the name. This borax is used by the inhabitants of Lhasa and Shigatze as a spice for meat, for tea, and for washing clothes, bathing, etc. It is carried away by the traders in great quantities.»*

In Captain Bower's journey we find nothing that throws any specially important light upon the physical geography of Tibet. His journey, which started at Simla on 4th April 1891 and lasted close upon eight months, led him right across unknown Tibet and through Asia to the coast. As a record of rapid travelling it is a good performance, and his map is in some respects always useful for fixing positions on the high plateau. At first he travelled through those parts of western Tibet which have since been examined much more accurately by Wellby, Deasy, and Rawling. He brushed the western end of the Panggong-tso and to a photograph of the lake affixes the legend, »frozen over in April», in itself a surprising statement. As early as July he notes incessant westerly winds, not seldom bringing with them rain, hail, and snow. In general his description leaves the impression, that on the high plateau the summer is by no means deficient in rain; however it happened not seldom, that they had difficulty in finding drinking water. Unfortunately the information given about the lakes is extremely scanty; *e. g.* on 6th April at Papuk:

»After leaving the small lake lying to the north of our last camp, we approached the Mangtza Cho Lake, and camped to the south of it. It is a fine sheet of water, of a deep indigo-blue, at an elevation of 16,540 feet. Round the lake there is an incrustation of salt, and people from Ladakh and Noh come for it in summer.» Again on the 20th July: »Over a pass 17,876 feet, and then down a long narrow valley which suddenly debouches on Lake Aru Cho (17,150 feet), — a fine sheet of water running north and south, salt like nearly all the Tibetan lakes, and of a deep blue colour . . . Heading round the north edge of Lake Aru Cho, we crossed a neck of land with another lake, or rather the nearly dried-up remnants of a lake, interspersed with patches of salt on our north.»

The high salinity of the ground is borne witness to in this note made at Camp 16 on the 24th July: — »On the road a number of pools, all more or less salt, were passed, but where we camped there was a spring of fresh water. All

* Montgomerie, *Narrative of an Exploration of the Namcho, or Tengri nur Lake in Great Tibet, made by a Native Explorer, during 1871—2*, in *Journal of Royal Geographical Society*, vol. XLV (1875).

over the country there are patches of saline efflorescence, and the sides of the stream beds coming down from the hills, dry at this time of year, were covered with it.»

Bower often speaks also of westerly storms and rain during the latter part of the summer. I have already touched upon his description of the Tschargut-tso, Selling-tso, and Naktsong-tso. Towards the end of his book he summarizes the experiences of his journey through the plateau region proper of Tibet in the following words: — »The whole of Central and Northern Tibet, and almost the whole of Western Tibet, is called the Chang; it consists of a high table-land, with hills mostly of a rounded character, with broad open valleys between, but here and there sharply-defined massy ranges are met with. The mountains have a general east and west tendency, but no defined watershed exists, and all the rivers terminate in salt lakes, which appear to be gradually drying up, as unmistakable signs, that at one time they occupied much more extended areas than they do at present, are to be seen. The whole of the Chang itself, however, forms a most distinct watershed: the rivers rising on the east find their way to Burma and China, while those rising on the south and west, penetrating the barrier of the Himalayas, emerge on the plains of India.

An idea of the general configuration of the country may be gathered from the fact that from the end of June until the middle of November the average altitude of our camps was over 16,000 feet, the lowest being 14,621 feet, and the highest 18,315 feet, while the highest pass crossed was 18,760 feet. All the enormous stretch of country crossed in that time contained not a single tree, and only two species of shrub, and these rarely exceeded 6 inches in height; flowering plants and grasses however were found, and Dr. Thorold collected 115 species, one of which was found at an altitude of 19,000 feet, probably the greatest height at which any flowering plant has been collected. Great stretches of this Chang afford excellent grazing in summer, but are too far from suitable winter quarters to be made use of by the nomads, so they are left to the wild yak, antelope, and gazelle, which are never disturbed, except by some wandering bands of Chukpas (brigands), who find these wastes an excellent asylum whence to swoop down on the tents of the nomads living on the border, or to retire to when pursued.»*

This brief summary of the physical geography by Bower agrees in every respect with my descriptions and those of other travellers.

Deasy, like Bower, devotes the greater part of his book to a detailed description of what happened during his journey, while a relatively insignificant part of it deals with geography. On the whole you derive from it a certain conception of the niggardly nature of Tibet; and on the other hand you look in vain for detailed geographical information. Notwithstanding this, Deasy's three years' journey is one of great importance; and its most important part is that which deals with western Tibet. Of that region he brought home with him an especially beautiful and valuable map, which was published in two sheets by the Surveyor General of India, and this was, through the kindness of Lord Curzon, placed at my disposal during my visit in India. The map bears the title »Map of Portion of Tibet, explored

* *Diary of a Journey across Tibet*, by Captain Hamilton Bower.

by Capt. H. H. P. Deasy, 16th Lancers, in 1896». To the results of the cartographical labours, not only of Deasy, but also of those travellers from whom I have quoted in the foregoing pages, proper credit will be given in the large general map that will accompany my atlas; consequently I need not linger over their maps here. The best of them all is Deasy's. With regard to the maps of his predecessors, that traveller's experience is the same as mine, namely that they are of very small value, and help you but little. Deasy says on this point: »This pass (Lanak La) was an easy one, but as to the country beyond I now felt some anxiety. We knew that Bower, Dalgleish, Carey and de Rhins, and possibly one or two other Europeans, had been over the ground, but the only maps we possessed were on too small a scale to be of much assistance.»

Deasy's journey took place between the years 1896 and 1899, and extended also over a large part of East Turkestan. I need not delay long over this traveller, especially as I have already mentioned those parts of his itinerary with which I came into contact in my 1901 journey. Still I will append one or two passages by way of samples of his style of writing. Of the country round the Aru-tso he says: —

»Striking contrasts in scenery are by no means uncommon in Tibet, as for instance, in the country around Aru Cho. On the western side of this lake, which we ascertained to be of a different size from that marked on the latest map of Tibet, there is a fine range of snow-clad mountains extending beyond the northern and southern shores of the lake, but on the eastern side there are only comparatively low mountains, none of which exceed 19,500 feet in altitude. Not far from the foot of the snow range in the south-west corner of Aru Cho there is an unusually large supply of wild rhubarb, which, though inferior to the cultivated kind, was not despised by us. The quality of the grass in this neighbourhood is infinitely superior to that of the coarse and very sharp kind, called »lungma» by Ladakis, previously encountered. Here a small, soft, fine grass, known to the Argûns as 'peelee', largely preponderated, much to the benefit of our impoverished animals, who greatly appreciated this more nutritive food.»

Deasy's experience was the same as mine and that of other travellers, that in western Tibet drinking water is in general rather scarce. Speaking of the district around Camp 50, he says: — »In this part of the country good water was difficult to find, and day after day we were obliged to content ourselves with such natural solutions of salt and soda, or such muddy mixtures, as the neigh-bourhood supplied. We could think of no method of removing the salt and soda; but by boiling the muddy liquid and adding a mere pinch of powdered alum a fairly clear water could be obtained. The privations of the wilderness, however, have their compensations, and the springs of water, fresh and pure, on which we at length lighted not only relieved our anxiety, but gave such keen enjoyment as only those who have suffered from similar inconvenience can understand.»

Speaking of the snow-fall in western Tibet he says: »The heights are constantly exposed to winds which sweep them clear of snow, so that they usually present some pasture available for the hardy flocks of the country. In these regions there seems to be no great snow-fall; on the heights it is certainly slight. We could discover scarcely any trail of avalanches, and, though we sought to determine the

snow-line, we could find very few data on which to generalise. No well-marked limit could be traced, but probably little snow lies all the year round in Western Tibet under 20,000 feet.»

»This neighbourhood contained many lakes which showed signs of a great contraction in area. The salt lake at the west of Kaze Chaka must formerly have been several hundreds of feet deeper than now. The difference of height between the mark at edge of Yeshil kul Lake and B end of Camp 109 (which is the former height of the lake) is 359 feet. The difference between Camp 63 of 1896 and the old level of the lake is 367 feet.»

By way of comparison with this, I may recall that the difference of altitude between the surface of the Lakor-tso and the highest beach-line that we could see amounted to 436 feet.

»At some places we were troubled with dust, but in this respect Camp 63 was by far the worst. By the beginning of October the minimum thermometer fell to within a few degrees of zero F., and soon after sunset it was impossible to write with ink.»

Deasy's observations in the source-region of the Kerija-darja are of great importance; but that region does not strictly speaking belong to the Tibetan plateau proper, at any rate it does not belong to its area of self-contained drainage, to which we are at present confining our attention.*

* *In Tibet and Chinese Turkestan, being the Record of Three Years' Exploration*, by Captain H. H. P. Deasy.

CHAPTER XXXIV.

CAPTAIN RAWLING. SOUTHERN TIBET.

In the summer of 1903 Captain Rawling undertook a journey in the country east-north-east of the Tso-ngombo, and thus came at several points into contact with the routes of the travellers last quoted. His map is excellent, and his paper in the *Geographical Journal* contains more geography than the books of several Tibetan explorers. I trust Rawling will give us a more detailed account of his journey in book form. I have entered his itinerary on my general map on the scale of 1 : 1,000,000, so that it will be possible to see what relation his journey bears to mine and those of other travellers in the same part of the world. I will now proceed to quote certain extracts from his paper which are so characteristic that without further comment they afford an excellent survey of the geography of that part of Tibet.

»This lake (Shemen Tso), which is over 100 square miles in extent, is bitterly salt, and in shape very irregular, with numerous rocky promontories running into it from east and west. At some former date it evidently occupied a much greater area. The shores slope gradually, and are covered with grass . . . About half a mile from the shores of the lake, at a spot where the camp was pitched, an area of about 5 acres in extent was covered with ice, over which lay a thick layer of loam, upon which grass grew luxuriantly.«

»Memar Chaka, the bitterly salt lake which we had now reached, has an area of about 50 square miles. The plain all around has a width of about 5 miles, the soil being rich and fruitful. Signs were plainly visible of the lake having been at some remote period about 80 feet higher than its present level. But few animals and birds were to be seen.«

»Beyond this undulating range of hills lay a lake entirely frozen over, and having an area of nearly 20 square miles . . . Round its shores, piled into great ridges, lay a snow-white mass of carbonate of soda and sulphate of magnesia. The outline of the lake was regular, and the shores flat, no vegetation growing within half a mile of the water.«

Of the country a few miles east of Jäschil-köl he says: »Borax was found in large quantities close to the tents. The surrounding country was impregnated with carbonate of soda and salt to such an extent that some of the streams were un-

drinkable. All of us suffered considerably from drinking the water which flowed past the camp, and it was not until a well had been sunk and fair water obtained that the ill effects left us.»

»The weather had of late been very hot, on one day the thermometer having registered 70° Fahr. in the shade. Thunderstorms rolled across the plains daily, either rolling up from the west or forming on Deasy group, and generally accompanied with snow . . . These storms were accompanied by hail and snow and terrible squalls of wind, which at times swept us from our feet and lowered the tents to the ground.»

»On August 6 we reached the shores of Lake Markham . . . Lying roughly north-east and south-west, Lake Markham has a length of about 17 miles, a width of from 4 to 5 miles, and an area of 70 square miles. It is regular in shape, and is bounded on the north by low rolling hills, and on the south by a rugged ridge. Its shores are composed of sand and shingle, and its banks shelve slowly. On its waters and along its shores breed in large numbers the Brahmini duck. No fish or shrimps were seen. A river with a strong current runs by many channels into the lake from the west. The water of the lake at its western end is fresh, but as one travels towards the east the water becomes more and more impregnated with salt, until at its eastern end it becomes undrinkable. At the time of our visiting Lake Markham there was no overflow, the surplus water being apparently absorbed by the soil, or lost by evaporation. There is, however, a narrow channel at the eastern extremity, which at this date was very dry, but which bore evidence that at some season of the year the water escapes by this channel and drains into the low-lying ground to the north, which is white with salt.»

»The country to the north and east appeared a barren waste. To the east the desert plain stretched for 50 miles, only broken by scattered salt lakes and pans, and by rocky knolls and pinnacles rising abruptly here and there. Beyond this again rose low-lying ranges and rolling hills. All around appeared dead; no fresh water, no vegetation, and no animal life — a veritable Dante's Inferno.»

»The ranges here ran north and south, the valleys between being full of low undulating grass-covered hills.»

»On August 20th the direction was again changed, this time towards the south-west, the caravan following the line of least resistance. The country to the south-east consisted of great salt plains and jagged ranges. In the centre of these plains lay salt lakes, all of which had the appearance of rapid diminution in size. In some places, in fact, only salt pans remained. The low-lying land for several miles round the lakes was void of vegetation, but on the highlands grass grew luxuriantly and game was plentiful.»

»Three marches further on the caravan arrived on the shores of Huping Tso, a fine sheet of fresh water almost divided into two by a rocky peninsula. The shore on three sides was flat and boggy, while to the south it was bounded by a rocky range, down whose precipitous sides many small streams added their quota to the volume of water. The lake, however, was mainly fed from the distant mountains to the north, upon whose summits snow still lay. The water was absolutely fresh; nevertheless, no wildfowl were to be seen. In the lake weeds and shrimps abounded, but we were unable to see any signs of fish. A broad and sluggish river flowing

from the western end, carried off the superfluous water, which finally drained into the low ground and salt lakes to the south.»

»During the month of September the sky remained free from clouds, and the annoying wind ceased to blow.»

»Before reaching the lake of Aru Tso, the caravan passed many salt ponds, and finally one small but bitterly salt lake. This lake formed the last vestige of what in olden times was a vast sheet of water, and it had without doubt been connected with Memar Chaka and Aru Tso. The old shores could be distinctly seen high up the mountain-sides. This lake must formerly have had an extent of over 70 square miles.»

»Aru Tso was reached on August 29th. On the shores of the lake the caravan halted, and here a most interesting and also important fact was noticed — the waters were fresh. Captain Bower visited this lake in 1890, camped upon and moved along its shores, and writes, 'Like most Tibetan lakes, it is, of course, salt'. Captain Deasy reached Aru Tso in 1896, and his report on the water was that it was drinkable — a term which, when used in reference to Tibetan travel, means that the waters are decidedly saline or foul. And now on our journey in 1903, at the end of August, the water was found to be fresh, absolutely fresh, without the slightest trace of salt or disagreeable mineral in it. This is certainly worth recording, if only for the reason that, as this change has been shown to take place in one great lake of the Tibetan plateau, it is quite possible that at certain seasons or periods other lakes may become altered in character. It is to be hoped that in course of time Aru Tso will again be visited and its water carefully tested.»

»The Aru Tso mountains run north and south for many miles, the western shores of the lake lying close to the foot of the range. These mountains are rugged and precipitous, and their summits are clothed in perpetual snow. The range would be impassable were it not for two cuttings opposite the southern shore of Aru Tso, where two streams have cut their way from the west right through the range. The passage through these openings is easy, as the beds of the streams are almost on a level with the waters of the lake.»

»Bum Tso has an area of about 5 square miles. It is a shallow lake, and is surrounded by flat muddy shores. The water is drinkable, but has a distinctly foul flavour. This without doubt results from there being no continuous overflow, though the lake is perpetually fed by the broad stream along which we had been previously travelling. In all probability Bum Tso overflows its banks at some season of the year; otherwise its waters would be salt.»

Not far from the lake Tai Tso Rawling came into touch with the river Khio, which is identical with my Tsanger-schar; and on his map we find on its bank, at Camp 81, the name Shankar Shah. He says: »This beautiful river poured out from a valley to the east, through meadows of rich short grass. From 30 to 100 yards wide, with a current of 2 miles an hour, it steadily increased in size, being continually fed by springs rising on every side. The bed at times was stony and firm, at others muddy and treacherous, though everywhere weeds grew freely and trout moved fearlessly along.»

From Noh to Bal Rawling followed the same route that I did along the northern shore of the Tso-ngombo, which he calls the Tso Mo Gualari, dividing it into the sections »Tso Nyak, the twin lakes Rum Tso and Nyak Tso.» He says that it »consists of a string of five lakes 120 m. in length, the four most southern of which are fresh, and Pangong, the most northerly, salt. They are joined together by channels about 60 feet in width and 15 feet deep, the current running at nearly 1 1/2 mile an hour.»

Rawling's paper thus abounds, as will be seen, in interesting observations. He was especially struck by the fact that all the salt lakes in the region which he traversed are now undergoing desiccation, and he gives a successful photograph of »beach-marks formed by receding water». He both mentions in his text and shows on his map mountain-ranges running meridionally, though often these ought rather to be regarded as ramifications of the main chains that stretch east and west or rather south-east and north-west. Nothing however surprised him more than finding water fresh in the Aru-tso, because Bower in 1890 found it salt and Deasy in 1896 pronounced it drinkable, that is slightly saline. The circumstance admits however of explanation in several different ways. In the first place, it is difficult to compare different people's taste in such a matter as salinity, depending as it does upon their varying standards of what constitutes drinking water. One person would pronounce water salt which another person would regard as drinkable. To one who for some time past has been accustomed to perfectly fresh spring water, the slightest flavour of salt is apt to be objectionable; on the other hand if the same man had during the same period been forced to put up with really salt water, then water with a slight tinge of salt in it would appear to be almost fresh. Properly speaking however the statements of the three travellers with regard to the water of the Aru-tso do not admit of comparison together, because they struck the shore at different places. Bower touched the lake at its northern end. Deasy's route, according to his map, ran at some distance from the western shore of the lake; but as the word »drinkable» is entered on its southern side, it is very probable that it was there that he tasted the water. And it was at the southern end of the lake that Rawling touched it. It is clear, that the salinity can vary a good deal at different places along the lake-shore; a fact that is quite evident from Rawling's own statements about Lake Markham, when he writes (as I have already cited), »The water of the lake at its western end is fresh, but as one travels towards the east the water becomes more and more impregnated with salt, until at its eastern end it becomes undrinkable.»

I also found similar circumstances in one of the lakes of western Tibet as I have stated above. The difference may be caused by shallow passages, subaqueous ridges, and sounds. Besides, the mere fact of a brook emptying into a salt lake is enough to cause the water in the vicinity of the spot where it enters to appear fresh, owing to the fresh water spreading itself out over the salt. A somewhat similar and quite simple cause is probably the explanation of the phenomenon which gave rise to Captain Rawling's astonishment. Yet one other possibility is not precluded, namely that the water of the Aru-tso is subject to periodical changes of salinity; that is to say, that its water is sometimes salt, sometimes fresh, though this

is only possible on the presupposition that the lake is very shallow and small, so that its entire volume can be renewed every year during the melting of the snows.

On Rawling's map we find a pair of lakes: across the northern lake, the Memar Chaka, is printed the word »salt», across the southern, the Aru-tso, the word »fresh». These are evidently connected by a small watercourse cut through the narrow isthmus that separates them. It is therefore clear that the fresh water in the last-named lake flows northwards into the salt lake, although the Aru-tso is shown on Rawling's map to have an altitude of 16,000 feet and the Memar Chaka an altitude of 16,070 feet. On Deasy's map the relations are however different, and manifestly more in agreement with the actual facts. For the northern, the salt lake, he gives the same altitude as Rawling, but for the Aru-tso he gives 16,210 feet, thus indicating, as might be expected, that the freshwater lake lies considerably the higher of the two. Bower probably exaggerates the altitude of the Aru-tso when he puts it at 17,176 feet. He gives no absolute altitude for the northern lake, nor does he appear to have come directly into contact with it. Whatever the real fact may be with regard to estimates of absolute altitude given by different travellers, one thing is pretty certainly correct, that Deasy's statement with regard to the relative altitudes of the two lakes is most likely to be the true one, and not least because he visited them both at one and the same time; whereas in Rawling's case a long interval elapsed between his visit to the northern lake and his visit to the southern lake.

With regard to the melting of the snow in this region Deasy gives the following information: »At one camp at the west end of the long valley leading into the lake north of and close to Aru Cho, the small stream by which we camped flowed only for a few hours daily, showing that the hot sun of a summer's day has only a very temporary effect on the glaciers at the western end of the snow range on the south side of the valley.» In any case these lakes owe their existence solely to the precipitation, and the precipitation is more abundant in the summer, especially in its latter half, and the snow too melts only in the summer. During the second half of the summer the inflow into the Aru-tso is certainly more copious than at any other season of the year. In case the lake really is, as I have supposed, particularly shallow, the succession of occurrences may be assumed to be as follows. In the spring and early summer the inflow is so insignificant that the evaporation is in excess; the lake is therefore entirely cut off and consequently salt. In the height of the summer, especially in the end of July, the inflow is so copious that the salinity decreases every day. The inflow, finally, reaches its maximum in August, and the surplus water then flows through the connecting river-arm to the Memar Chaka, and in consequence of this the Aru-tso gradually becomes fresh. In proportion as the inflow decreases in amount and the outflow into the northern lake ceases, the lake, being then disconnected, grows increasingly salter. If this order of procedure is correct, it is no longer difficult to understand, that on 20th July Bower found the lake salt, that Deasy on the 29th July pronounced it »drinkable», and Rawling on the 29th August found it perfectly fresh. Similar relations, depending upon configuration and situation, are easily conceivable in the case of several other lakes in Tibet.

With this I will conclude my general survey of exploring journeys in Tibet, the object of which was partly to do full justice to the explorations and observa-

tions of my predecessors and colleagues and partly to set forth as clearly as is possible through the mouths of eye-witnesses the character of that plateau region. My survey must not in any sense be regarded as a historical *résumé*, nor *can* it indeed be such, because I have of deliberate purpose selected only those routes which touch the plateau country proper. Of the Russian travellers I have consequently drawn upon Prschevalskij alone; no others have approached the plateau. The account of Grombtschevskij's journey has not yet, so far as I know, been published, so that the results of that expedition are, as it were, swallowed up in the efforts which English travellers in particular have made within recent years to explore western Tibet.

Nor have I in this connection bestowed any attention upon southern Tibet, with the valley of the Tsangpo and the region in which the Indus has its sources; it is a country that is at all events essentially different from the interior of Tibet. True, not many journeys have been carried out in southern Tibet; but any consideration of them would lead me outside the limits of the task which I proposed to myself; I hope however in the future, partly in southern Tibet itself, partly by means of a historical survey, to be able to turn my attention to that part of the country. I would refer those who may be desirous of studying the journeys which have been made in southern Tibet to the *résumés* already mentioned, namely Richthofen's *China*, vol. I, Wegener's and Sandberg's books, and also to a study by S. Oldenburg in *Journal Ministerstva Narodnava Prosvjäschtschenija*, bearing the title of *The Newest Literature about Tibet*. Despite its title, this last paper devotes far more attention to what was done in Tibet formerly than to what has been accomplished recently. His comments, which are very polite in tone, upon Grenard's popular book, *Le Tibet*, ought properly to be compared with what that traveller tells us in his great scientific work, and the admirable qualities of his map ought to have been pointed out. Oldenburg's essay, which is particularly interesting and exhibits great knowledge of the facts, culminates in an attack upon English policy in Tibet.

I also have written a similar essay in the same spirit.* That the forecast which I there made has proved true is in no way dependent upon the manner in which the expedition was carried through, for that was in every respect exemplary, but is due solely to Mr. Brodrick's short-sighted method of protecting the interests of England in that part of Asia, and his inability to render the expedition fruitful of results, both politically and geographically. In the paper in question I ventured to make the following closing observation. »And, that I may point to at least one bright spot in this dark picture, let us hope that, if England does make her influence effective in Tibet, she will at least have the country opened freely and without restriction to scientific exploration. The last hour of the closed door policy will then have struck and all avenues will stand wide open to the eager investigator.» What I meant by this is not difficult to understand. I hoped that within the course of ten or twenty years Tibet will be thoroughly traversed from end to end and from side to side, and its geographical, orographical, and geological problems will be investigated, at all events in their broad outlines; in other words, that the white patches on the map of Tibet will be filled in with lines and hatchments indicative of mountains, rivers, and lakes, and that the pioneer work will be accomplished, and everything ready for the slow and patient investigation of details.

* *Der englische Angriff auf Tibet*, in *Die Woche*, 18th June 1904.

CHAPTER XXXV.

THE ENGLISH EXPEDITION TO LHASA.

Since I wrote the above words various works have been published about the English expedition to Lhasa, and in connection with them I cannot abstain from adding a few remarks with regard to the geographical results of the expedition. I had hoped that, if nothing else was gained by the expedition, it would at all events have thrown the country open for the future; but in one of the books alluded to I find the following passage: »There is no doubt that even now as I write Tibet has again been trebly barred against the foreigner; but if by force or fraud another traveller shall find himself at Nagartse, let him go ten miles to the south-east and climb the saddle of the Ta la.» And further: »Never again will the lonely isolation of the Forbidden City call out all that is best in a race of pioneers. Her challenge no longer rings across Asia, and the echoes of more than the call have died out with it. It is true that the curtain has again fallen, and fallen more impenetrably than before; it is true that in all probability no other living white man will ever see the brown mice of Palden-lhamo, or watch the lazy ascending line of blue incense smoke in the chapels of Na-chung Chos-kyong — but the charm of Lhasa is for ever broken.»*

Thus the curtain has once more fallen, and all that has been won for the future is that the frontiers will be guarded with treble zeal against the approach of foreigners. Any way we may comfort ourselves with the reflection that only one year before the English expedition started the jealous exclusiveness of the Tibetans was enforced with great vigilance. Turgut and Tsajdam Mongol pilgrims, then on the way to Lhasa, were willing enough to report the approach of a caravan from the north. And now, I have no doubt, there will be a host of self-appointed spies ready to carry to the lamas for a slight reward everything they see and hear. Still we may venture to join in Mr. Douglas Freshfield's hope, that Lord Curzon, himself one of the most distinguished of living Asiatic explorers, and a devoted friend of geographical science, will succeed in despatching one or more geographical ex-

* *Lhasa, an Account of the Country and People of Central Tibet and of the Progress of the Mission sent there by the English Government in the Year 1903—4*, by Perceval Landon. II, pp. 96 and 340.

peditions. One thing at any rate is certain, that he will do all he can to render the lamas amenable to reason, in so far as political obstacles do not intervene. The inexplicable and very inopportune passivity in face of the interference of Russia has even led us to fear the evacuation of the Tschumbi valley, a step which would be interpreted by the Tibetans as weakness and would destroy the effects of Lord Curzon's Tibetan policy. In that case it would be necessary to wait for a legal Anglo-Russian constellation before that policy could be guided to a consequential issue, and until that happens geographers must just wait patiently. In view of the energy and far-sighted purpose and political sagacity which characterize everything that Lord Curzon undertakes, we may rest assured that he will not draw back from a task which he has once taken in hand nor be content with half measures.

If in the future Tibet becomes guarded with threefold greater jealousy, the question arises, what will become of the active traffic from which Landon expects so much? I have previously been so bold as to express my doubts with regard to this point, and Candler says, »But the whole trade between India and Tibet is on such a small scale that it might be in the hands of a single merchant».* What are the goods which will be offered to the Tibetans in the new markets that have been opened? No answer can be given to this question until the traffic is actually started and organized; but it must not be forgotten, that on the English side this traffic is only a means for getting into friendly communication with the inhabitants of that so jealously guarded country.

It would be unjust to demand that the geographical results of the English expedition should bear anything like a reasonable relation to its costs, and we ought to remember that geographical discovery and exploration formed no part whatever either of its programme or its task. Had the expedition cost only the sum that was first asked as a war-indemnity from the Tibetans, namely half a million sterling, it would have been sufficient for at least a hundred expeditions of the same kind as that described in the present work!

In its main features the part of Tibet which was traversed by the English mission was already tolerably well known; and of this a clear proof may be obtained by glancing at the first-rate map published in *Petermann's Mitteilungen*,** before the English expedition accomplished its object. The route from Phari to Gyangtse and on to Schigatse was mapped as far back as 1783 by Turner, and speaking of this map Landon gives the following excellent testimony: »A very good piece of work, better than the best London maps of 1903.»*** In the year 1878 the Pundit A—K— travelled *viâ* Tschumbi and Phari-dschong, the same road that Bogle took in 1774 and Manning in 1811. Turner's map has of course been in several respects improved as a consequence of the excellent means at the disposal of the English expedition.

The route taken by the expedition from Gyangtse *viâ* Jamdok-tso, across the Tsang-po, to Lhasa is exactly the same as that which was travelled over and admirably mapped by Chandra Das. Of the country traversed by the recent military

* *The Unveiling of Lhasa*, by Edmund Candler, p. 31.
** Jahrgang 1904, Tafel 7.
*** *Lhasa*, I. p. 19.

expedition the most interesting portion from the physico-geographical point of view is without contradiction along the north-western shore of the Jamdok-tso. On the Jesuits' map this lake, which they called Pelti or Palti, is represented as a perfect ring, though in this respect it is somewhat modified on d'Anville's map of 1735. Reclus has a reproduction of this last, and when speaking of the Tibetan lakes he says: »Entre autres le Yamdok ou Palti, que l'on représente sur les cartes, d'après d'Anville, sous une forme presque régulièrement annulaire, comme celle d'un fossé entourant une citadelle. L'île, que d'ailleurs quelques descriptions représentent plutôt comme une presqu'île, se dresse à plus de 700 mètres de hauteur au-dessus de la nappe des eaux, qui se trouvait elle-même à 4114 mètres d'altitude.»* Reclus's information belongs to the year 1882, the year in which Chandra Das concluded his journeys. The travelling companion of the last-mentioned, a Buddhist named Ugyen Gyatso, trained in the Survey of India, and clearly an exceptionally intelligent and conscientious topographer, made a map of the Jamdok-tso, which the members of the English expedition were unable to improve upon except in unessential particulars. It possesses also the advantage of including nearly the whole of the lake except the north-eastern shore and peninsula; while, to judge from Landon's and Waddell's maps, the English expedition touched only the north-western shore at the points where Manning also touched it in the year 1811. The subsidiary lake Dumu-tso is plotted in such detail as to suggest that it must have been visited during some side-excursion. The eastern part of the lake does not however appear to have been personally visited, but is copied directly from Ugyen Gyatso, who was the first to prove that the lake does not form a perfect annular sheet of water embracing an island. At the base of the peninsula Ugyen Gyatso shows a deep bay and a small lake, Dumo-tso; but the new map shows two small lakes. This constitutes the real difference between them; nevertheless it does not necessarily prove that the native surveyor was mistaken. The northern subsidiary lake forms the direct continuation of the bay, and is at the present time separated from it by an isthmus that rises but slightly above the water, the whole forming one extensive marsh, dangerous for a man on foot to tread upon and inaccessible to a horse. Probably if the surface of the Jamdok-tso were to rise one or two feet this isthmus would be put under water, and we should then have precisely the same map that Ugyen Gyatso gives us. The journey of the latter dates from 1881, that of the English expedition from 1904; consequently twenty-three years intervene between their respective maps, and I am convinced that there exists no reason why a change should not have taken place such as that indicated by the difference between the two maps. In vast numbers of lake-depressions throughout the whole of Central Tibet, all the way to the Pang-gong-tso, we have observed remarkably striking signs of a progressive desiccation. In some cases we have found that the old strand-ramparts run one above the other like the rows of benches in a Roman circus; in fact, in one place we came across a beach-line 133 m. above the existing level of the lake. Yet there is no need to have recourse to this phenomenon, which is connected with climatic changes affecting the whole of Tibet, in order to account for the difference between the two

* *Nouvelle Géographie Universelle*, VII, p. 47. According to Landon's map the altitude of the lake is 4570 m.

maps. It is, I admit, quite true that, as I have already mentioned, Nain Singh on his map of 1874 shows the Luma-ring-tso in western Tibet as being much bigger than I found it in 1901. But, although of the former lakes there now remains in many places nothing except a bed of gypsum, fantastically modelled by winds from every quarter, it is nevertheless not credible that the desiccation proceeds so rapidly as to be noticeable within the space of two or three decennia. But an easier explanation can be found if we call to mind the Brückner periods; besides, we have no knowledge whatever as to whether the level of the Jamdok-tso is or is not dependent upon the seasons. In several of the lakes of Tibet, both fresh and salt, we have had occasion to observe a rise in level when the snows begin to melt in the spring on the surrounding mountains. Now as it happened, Chandra Das and his travelling-companion passed between Nagartse-dschong and Pedi-dschong in the end of May, and the English expedition in the end of July. On the former occasion the thaw-water was streaming down to the lake from every direction; on the latter occasion the inflow had passed its maximum stage, but evaporation was very active and was rapidly lowering the level again. It is therefore very probable that both maps are correct and that the isthmus is under water in the spring. And the likelihood of this supposition being true is strengthened by the fact that at the end of July the innermost part of the bay is called on the English map by the name of Jamdok-tso, just as the principal lake is, so that it is evidently regarded by the Tibetans as being a part of that lake rather than as a permanent, independent side-lake.

It is a matter of less importance to ascertain whether it was Ugyen Gyatso or Chandra Das who drew the map of the Jamdok-tso. According to Landon the merit of this belongs to the former, whom he calls »one of the best of our native explorers»; but according to Rockhill it was the latter who is the author of the map. In his preface to Chandra Das's book, Rockhill says, that when the latter set out on his second journey in 1881 he »was again accompanied by Ugyen Gyatso, who acted as secretary, collector, and surveyor, though much of the later work, including the extremely important survey of Lake Palti (Yamdok-tso), was done by the traveller himself».

According to what Landon and Waddell say, the Jamdok-tso is undergoing a process of desiccation, although their statements are not backed by any reliable figures. The former says: »There is, perhaps, much excuse for the old belief, that the Jam-dok-tso is indeed a ring of water, for in the two wide places where the great circle is broken the shaking stretch of black mud is even now more kin to water than to land . . . A hundred years ago it must have been shallows — a thousand years ago, perhaps, the old level betrayed on the hill-sides to this day was awash. Forty feet added to the present height of the water would change the shape of the lake curiously indeed.»* In Waddell we find the following interesting statement: »Although this magnificent curve of landlocked water winding among the hills is not now a complete ring, it probably was so originally in its glacial period, when its waters overflowed the stony promontory of the Tag or 'Rocky' Pass. It certainly must

* *Lhasa*, II, p. 94.

have been almost a complete ring in comparatively recent historical times, when it was continuous with the Devil's Lake across that narrow isthmus now so consolidated that we cantered over it on the way on our visit to Samding. Its two ends are only separated by the Tag ridge. The people say, and indeed there is ample evidence, that the larger lake is drying up and receding. As we passed along its shore we could see the old tracks on the hill-side 20 to 30 feet above the present road, and in the side valleys were well-marked shallow terraces, for 100 feet or more, marking evidently former levels of the beach. Its water undoubtedly extended in former times up the side valley, down which we came to near the Kharo Pass, as the shelving shingly plain, spotted with white saline incrustation, forming the bed of that valley, was clearly continuous with the floor of the lake. The level of the water nowadays fluctuates within narrow limits from year to year, and with the season according to variations in the local snow and rainfall. The desiccation of this lake is doubtless due in part to the increased evaporation consequent on the disappearance of its glaciers and glacial feeders permitting the air to become warmer, whilst the rising of the Himalayas, which has continued up to recent times, must have cut off a considerable amount of its former rain supply. The water of the lake tasted slightly saline, as was to be expected in a lake which had no outlet, and which was fed by rain and snow from the hillsides, dissolving portions of the lime and other rocks, and an evaporation leaving the salt behind; but although slightly brackish it was quite drinkable and made good tea.»*

With regard to the Dum-tso (the »Devil's Lake») Waddell says: »It is on practically the same level as the Yamdok, not more than 1 or 2 feet higher, and is merely a portion of the latter which has become detached and isolated by the drying up of the waters of the great lake.»**

I cannot here let slip the opportunity of pointing out the extremely remarkable geographical homology that exists between the Jamdok-tso and the Naktsong-tso, which I mapped and in part sounded. Both these lakes have been formed by nature on precisely the same model, and it must be pronounced a very singular thing that a lake which is intrinsically abnormal in shape should be paralleled by another at no great distance away. The resemblance between the two lakes is at least as great as that between the islands of Celebes and Dschilolo (Jilolo or Halmahera) in the East Indian Archipelago. The photographs of the Jamdok-tso which were taken by the members of the English mission might equally well pass for views of the Naktsong-tso. The most important differences between the two lakes lie partly in their size, the Jamdok-tso being a good deal the larger, and partly in the fact that the rocky island of the latter is connected with the mainland on the west by three narrow strips of ground and consequently is in reality a peninsula, whereas the island of the Naktsong-tso is united with the mainland by merely a narrow alluvial isthmus of a wholly secondary character, it too being on the west. In both alike the greatest expanse of water lies east of the island; in both alike the shores are fringed by smaller islands, headlands, and bays; and in both alike there exists a tiny isolated

* *Lhasa and its Mysteries, with a Record of the Expedition of 1903—1904*, by L. Austin Waddell, p. 298.

** *Op. cit*, p. 297.

islet close the south-east shore. Both these lake-basins are, beyond doubt, like so many others in Tibet, reminiscenses of a long vanished glacial period.

My sole object in recalling the fact to which I have adverted above was to show that the regions visited by the English expedition were already relatively well known before. But, the object of the expedition having been accomplished, why was not the opportunity seized of furthering the cause of geographical exploration? Candler points out in his book, and quite justly, that then for the first time within a century an opportunity presented itself of solving the problem of the connection between the Tsangpo and the Dihong or Brahmaputra. How long have not geographers reasoned about and discussed the problem of the lower course of the greatest river of Tibet, whether after its issue out of the mountains through what in point of size is one of the most magnificent transverse gorges in the world, it drains the woods and valleys of Assam and then mingles its waters with those of the Ganges in the vast delta of that river near the metropolis to India, or whether under the name of Irawadi it directs its course through Burma to the confines of the continent.

Recently however it has been agreed that the Tsang-po and the Brahmaputra are one and the same river. Lieut.-Col. Waddell has in an original way endeavoured to prove the fact etymologically, both the Tibetan and the Sanskrit name signifying »Brahma's son».* He localizes its great fall, probably one of the most beautiful and one of the most imposing on the earth, in 29° 36′ N. lat. and 94° 47′ E. long. At the foot of the fall, where the water boils and thunders amid clouds of scattering spray, stands a monastery, a pilgrim resort, buried in sub-tropical greenery. A devil king, represented in the usual Tibetan manner, dwells in the frothing columns of the waterfall itself, and the forces of nature which are there displayed before the pilgrim's eyes are in a high degree calculated to render this demon sovereign an object of submission and dread. But as yet no white man has seen that wonderful region: there still remains a pretty wide gap between the reconnaissances which have been carried out by the Pundits from the north and Englishmen, especially Needham, from Assam. Thus one of the greatest and most attractive of geographical and geological problems still awaits solution in the »breaching» glens and gorges of the Indo-Chinese rivers, especially that of the Brahmaputra; for this stream is not merely remarkable geographically in its mysterious sweep round the eastern end of the Himalayas, but it also occupies an important place from the historical and religious point of view. So far as human knowledge reaches backwards in time its never slumbering waters have been indissolubly associated with the destinies of the Tibetans and the races of north-east India. With regard to this problem Waddell says: »It is, however, the Lower Tsangpo Valley, below the Ferry, which is the most interesting and important, both from an economic and a geographical point of view. For the Tsangpo, the central river of Tibet, is now proved almost beyond doubt to be the upper source of the great Brahmaputra river of Assam, and along its banks therefore would be the natural inlet to this country from the Indian plains, whilst in the Lower Tsangpo valley would seem to lie the richest and most genial tract of

* *The Falls of the Tsang-po and Identity of that River with the Brahmaputra* in *The Geogr. Journal*, vol. V, p. 258.

Tibet, resembling Kashmir in appearance, and giving access to the gold-mines east of the Jamdok Lakes.»*

But no expedition has ever penetrated into that region, although it would, I am certain, yield a richer geographical harvest than the great Lhasa expedition. Younghusband, himself a distinguished geographer, was actively interested in the idea of such an expedition. Indeed all preparations were made, and Captain Ryder was appointed chief of the enterprise. But the very day before they were to start from Tschaksam, there came a message from Simla countermanding the undertaking. Candler complains of the unreasonableness of the military authorities: »They had come through so far without a single disaster, and it seemed that no scientific or geographical considerations could have any weight with them in their determination to take no risks.»**

Another geographical task which the English officers were expected to accomplish was to connect their own route from India with the network of itineraries which I had traced in Central Tibet. The gap which confronted them here was even smaller than that along the Brahmaputra and much easier to bridge over; but the project of bridging it over met with the same fate: it was prohibited. Candler is quite right when he says: »An expedition to the mountains bordering the Tengri-nor, only nine days north of Lhassa, would have linked all the unknown country north of the Tsangpo with the tracts explored by Sven Hedin, and left the map without a hiatus in four degrees of longitude from Cape Comorin to the Arctic Ocean. But military considerations were paramount.»*** He might have said however two degrees of latitude, for the hiatus in the long distance from Cape Comorin to Cape Tscheljuskin is no more. Dschallok, the point at which I was compelled to turn back, is situated according to my observations, in 31° 45′ ½ N. lat. and 90° 46′ E. long. or 240 km. from Lhasa. By means of the postal system, organised in the Chinese way, a letter can be sent, as I learned, from Dschallok to Lhasa in a single day. It was considered that a caravan like mine would require five days to perform the journey, and not half a month, as Waddell tries to make out in his book (p. 451); and if the journey were taken in easy stages, and some attention bestowed upon the Tengri-nor in passing, it could be done, as Candler suggests, in nine days.

It would not however be sufficient to connect cartographically with the lowest point reached by me, it would also be essential to link up with the itineraries of other travellers. When you study a map of Tibet, with the routes of travellers plotted on it, you see how the majority of them converge upon Lhasa. Prschevalskij, Bonvalot, Bower, Rockhill, Dutreuil de Rhins, Littledale, and I were all compelled to turn back when within a more or less short distance of that city. The 102 officers of the English expedition were masters of Lhasa for five weeks: they were like the spiders at the middle of the web the strands of which were broken off quite near to them. Had the opportunity been seized, by means of small parties radiating out from the centre, to pick up as many of these loose ends as possible, the expedition would have been entitled to high rank from the geographical point of view. But

* *Lhasa and its Mysteries*, p. 434.
** *Op. cit.*, p. 230.
*** *Op. cit.*, p. 237.

as matters turned out it cannot claim any place at all in the history of geographical discovery. That old and well-proved explorer of the Himalayas, Freshfield, has indeed attempted to make the best of the geographical results obtained, but the attempt is at the best feeble.* Candler in his sincere and outspoken way is also right when he says: »In European scientific circles much was expected of the Tibetan Expedition. But it has added very little to science. The surveys that were made have done little more than modify the previous investigations of native surveyors.»**

Candler dwells upon the fact that the only exploring plan that was carried through was of subordinate importance as compared with the projected excursions towards the Tengri-nor and the Brahmaputra. And in this again he is right. The members of that expedition were Captains Ryder, Wood, and Rawling and Lieut. Bailey. They travelled westwards up the course of the Tsangpo, and crossing over the Schipki pass reached Simla in the beginning of the year 1905, having in three months covered a distance of 1300 km. The telegraph announced that they brought back with them a rich geographical harvest. Unfortunately the route which they traversed is one of the few in Tibet which had been already mapped. It was in the year 1865—66 that the incomparable Nain Singh performed the famous journey an account of which was admirably published by his instructor, the then Captain T. G. Montgomerie of the Great Triogonometrical Survey, in the *Journal of the Royal Geographical Society* under the title *Report of a Route Survey made by Pundit* — from Nepal to Lhasa, and thence through the Upper Valley of the Brahmaputra to its Source.*** The paper is accompanied by an excellent map. The work that was accomplished by the Pundit is divided by Montgomerie into four sections: (1) Thirty-one determinations of latitude with the sextant; (2) mapping of a distance of 1200 miles through absolutely unknown country; (3) temperature observations and fixing the absolute altitude of 33 stations by means of the boiling-point thermometer; (4) the keeping of a diary, with descriptions of the new year's festival at Lhasa, etc.

Wonderful men those Pundits! The English have made extraordinarily clever use of their intelligence and fidelity, and in many cases the pupil has excelled the teacher. They work with the accuracy of selfregistering instruments, and wherever their labours have admitted of control their trustworthiness has been fully demonstrated. In making practical use of the natives in this way the Russians have not advanced very far. How easily they could long, long ago have shed light upon the geography of East Turkestan, Mongolia, and Tibet with the help of the Buriats, who in respect of intelligence leave nothing to be desired. Previous to Nain Singh's journey, and it is now 40 years since that took place, East Turkestan and the whole of Tibet were perfectly unknown. Over the interior of the vast Asiatic continent there hovered a pale reflection, faint and shadowy, of the journeys of Marco Polo and the old Jesuits; but that was all.

* On the 19th January Freshfield delivered an address on the expedition before the Indian section of the Society of Arts. His hope, that some means may be hit upon of converting the temporary occupation of the Tschumbi valley into a permanent occupation, was not very happy in the light of the repudiation of Younghusband's action in making that temporary occupation.

** *Op. cit.*, p. 237.

*** Vol. XXXVIII. (1868), pp. 129 ff.

With regard to Captain Ryder's expedition, let us hope that he has surpassed his predecessor. But let us also at the same time bear in mind that Nain Singh shortly before he set out on his journey had been trained in probably the very best school that any explorer has ever been able to profit from: for two years he had shared in the journeys of the brothers Schlagintweit in Ladak and Kaschmir.

The address which Younghusband gave before the Royal Geographical Society is published in the May (1905) number of the *Geographical Journal* under the title of *The Geographical Results of the Tibet Mission.* When the leader of that expedition, himself a distinguished explorer, delivers an address with the above title before the most illustrious geographical society in the world, one has every reason to expect to learn something from it, but I must honestly confess that this expectation has in my own case resulted in disappointment: the paper affords abundant evidence throughout of the correctness of the opinions to which I have given utterance. Rawling and Ryder's expedition is the only one that affords any warrant for the concluding words of the paper: »I trust, therefore, you will believe that the Tibet Mission has not been barren in geographical results.»

Captain Ryder in the course of his journey westwards is said to have mapped 40,000 sq. miles of country, including the source-regions of the Brahmaputra, Indus, and Satlej — all in three months! Such a statement can only be received with scepticism, when it is borne in mind that, although the expedition marched beside the Jamdok-tso, it omitted to sound its depth, notwithstanding that it carried boats with it, and the boats of the natives likewise lay beside the shore. Both the war-correspondents and Younghusband speak of the deep blue colour of this lake, which has given occasion to one of its names, the »Turquoise Lake», and wonder whether that colour is due to the purity of the atmosphere or to the depth.

The information about the climate is not exhaustive. It is not sufficient to tell us that the wind blew hard without a break during January, February, and March; we also want to know from what quarter it blew, whether from the west, as throughout the whole of Central and Northern Tibet, or whether other laws govern the winds in the relatively low valley of the Tsangpo. According to Waddell's meteorological tables the prevailing winds in winter and spring blow from the south-west and south. Another discovery is not in accordance with the actual circumstances. Younghusband relates, that when the expedition left Gyantse on the 14th July they were a good deal hindered by heavy rain, and they were speedily disabused of the idea that Tibet is a rainless country. I had already made the same experience three years before in the same month, and in the evidence of this I need only point to a few passages in the account of my ride towards Lhasa.* »The worst of all was the rain; it came down like a deluge. I have never seen it rain faster . . . The rain continued to stream down without intermission; its monotonous patter-patter drowned all other sounds . . . It rained as it only rains in Gilan and Mazanderan; in fact, the only place where I have seen rain anything like it was at Asterabad . . . Five minutes after we left Gom-dschima the inevitable rain began again, and we were very soon wet through . . . It rained as if — as if the sluice-gates of heaven

* *Central Asia and Tibet.*

were pulled up . . . The rain came down in dead earnest, and . . . we soon had to go out and dig a trench all round the tent to head off the water. And on the 8th August I noted: »All night it poured with rain.»

In a word it rains in my book far more than it does in all the books of the war-correspondents taken together, and it is an error to suppose that the Tibetan rain was one of the extremely few geographical discoveries of the English expedition.* Still it would be ungracious to dwell any longer upon such small matters. Younghusband's paper is written in the simple but fascinating style which distinguished his earlier works. Nor must we indeed forget that the object of the expedition was political, and that its scientific results will no doubt be published in due time.

* In a criticism of my book *Central Asia and Tibet*, printed in the *Literarisches Zentralblatt*, Prof. A. Kirchhoff says also: »Die Fabel vom niederschlagsarmen Tibet muss fortan aus der Wissenschaft schwinden. Vielmehr erscheint uns Tibet als das Wunderland, wo auf Tage wüstenhafter Trockenheit, an denen der Boden unter ärgster Verdunstung in zahllosen Rissen berstet, die furchtbarsten Entladungen von Gewitterstürmen, Hagelschlägen, Schnee- und Regenfällen intensiver Art und mehrtägiger Dauer folgen.»

As appears from the author's statements in the following chapter, it was his intention to add to his Atlas a general map of the scale 1: 1,000,000, embracing his own routes and those of other travellers in Tibet. The preparations for such a map had, however, on the author's departure to India in October, 1905, not proceeded so far as he himself had hoped when he wrote the words found below on pages 542 and 547. To execute in his absence even a »provisional» map, which he would be able to declare valid as a »first edition» for a future better map, has been found impossible by the chartographers to whom he entrusted this work. Dr. Hedin's new journey in Tibet has furthermore been accompanied by considerable geographical results; without a particular knowledge concerning them such a general map as is here in question would be antiquated even on its first appearance. He will no doubt after his return supply the omission which must now occur in his work.

OROGRAPHY OF CENTRAL TIBET

CHAPTER XXXVI.

GENERAL MAP OF TIBET. KWEN-LUN BORDER-RANGES.

In the preceding chapters I have attempted to bring together the statements and descriptions of other travellers which can serve to throw light upon the structure of the interior of Tibet and in general elucidate the nature of its physical geography. Lower down I shall endeavour in succinct terms to give a sketch of its general relief in so far as that can be constructed from the observations and experiences of myself and other travellers. But before proceeding to do that I will, according to my promise, try in some measure to explain the orographical structure of those parts of Tibet which I know from my own experience, backed up by the accounts of my predecessors.

I had imagined that this reconstruction of the existing materials would not be a particularly difficult task, and that the red lines which mark the journeys of the different travellers on a general map of Tibet would be sufficient to permit of the various mountain-ranges being traced and located with a very fair degree of certainty. We have to conceive of Tibet as being, like the Iranian highlands, a gigantic »Faltengebirge», or a great number of mountain-ranges running on the whole parallel to one another and crowning a vast upswelling of the earth's crust. We have also to imagine these ranges, at all events the biggest of them, as forming continuous crests of varying height, and rising here and there into vast swellings capped with perpetual snow and glaciers, with in other places lower connecting saddles, which afford more or less convenient passes. Between these principal ranges there exist others of secondary rank, they too invariably parallel and stretching from east to west, though there are minor deviations in certain localities and in the north-western curve that characterises western Tibet. Certain attempts have, it is true, been made in the light of our existing knowledge to frame a map of the mountain systems of Tibet and the directions of their strikes, as, for example, by Dr. G. Wegener and by F. Grenard. The former, making use of all the material available in 1891, constructed a map, »Uebersicht des Kwen-lun Gebirges», which, considering the time it was made, was very meritorious; it must be remembered that most of the more important journeys across high Tibet belong to a later date than the year named. With regard to the situation and direction of the ranges Wegener

relies chiefly upon Richthofen, Prschevalskij, A— K—, Nain Singh, Carey, etc.; but the three great journeys which previously to that time had been made right across the highlands, namely Nain Singh's, A— K—'s, and Bonvalot's, were not sufficient to give a trustworthy idea of its general structure, and Wegener's map is in consequence only approximately correct. Looking at the eastern half of Tibet, we find that he makes the ranges run too much in a north-west and south-east direction; but the cardinal error, which *à priori* imparted to his map an appearance of great improbability consists in this, that he represents all the ranges of northern and north-eastern Tibet as proceeding from a main range which forms the northern rim of the highlands, separating it from East Turkestan, and to which, following Prschevalskij, he gives the extremely unsuitable name of »Russische Kette». That there does exist a great border-range of that character we know very well. But then the ranges in the interior of the highlands have nothing whatever to do with it; they do not break away from it as branches and ramifications, but they run parallel to it, and are so far of the same orographical rank as the border-range itself, in that each constitutes an equivalent fold in the earth's crust, the only difference being that some of these folds exhibit a more powerful and energetic sculpture and relief than others do.

Fig. 353. VIEW OF THE BOSTAN-TOGHRAK VALLEY; LOOKING N.

In his *Carte de l'Asie Centrale* Grenard has made a similar attempt, and having more copious materials to draw upon, and having moreover seen the country with his own eyes, he has succeeded better. The position and direction of the mountain-ranges are clearly indicated by darker lines and the predominant parallelism is clearly brought out. Nevertheless the map stands in need of correction in various

details. On the whole it agrees very closely with my own, showing a level plateau traversed by a number of mountain-ranges stretching east and west.

When however I attempted myself to draw a similar orographical map, I discovered that the task was beset with the greatest difficulties, and in the matter of the direction in which the ranges run real certainty can be attained within narrow limits only, namely in those regions in which the travellers' itineraries lie close together. This is the case, for example, with the region between the Astin-tagh and the Kum-köl basin, where I have myself crossed over the ranges in so

Fig. 354. THE EXIT OF THE MÖLDSCHA FROM THE MOUNTAINS; LOOKING SSE.

many places that even in default of any other material I should be able to draw the ranges which exist there. The same thing holds good, although to a less degree, of the whole of the broad zone which lies south of the region just mentioned and stretches thence southwards to the basin of the Selling-tso and the Tengri-nor. In the extreme west of Tibet it would also be possible, with the help of the older, and especially of the more recent, itineraries, namely those of de Rhins, Deasy, Wellby, Bower, and Rawling, to set forth the broad features of the relief of the country. On the other hand it would be labour wasted to attempt to define the ranges in the heart of central Tibet, and in the country between Nain Singh's route and the valley of the Tsangpo. In fact, the results of any such attempt would have

to be constructed to such a great degree upon guesswork that they might with justice be pronounced valueless, or at all events useless for scientific purposes. And it requires but a slight study of the available material, and observation of the many white patches that exist between the middle portions of Wellby's and Bower's routes, and also south of Nain Singh's route, to be convinced that so it indeed must be. For these reasons I was obliged to let drop my original purpose of attempting to trace the mountain-ranges right across the Tibetan highlands; that is, to prolong the ranges which I crossed over in the east in a westerly direction until they become lost in the world of mountains which have been traversed by Deasy, Rawling, and others. What prevents this from being done are the big gaps in the heart of the country, and anyway the difficulty of the task becomes apparent when the great

Fig. 355. THE MÖLDSCHA VALLEY; LOOKING N.

differences are borne in mind which obtain between the relief of eastern Tibet and the relief of western Tibet. If we may judge from the maps of the travellers last named, the impression is involuntarily borne in upon us that in the west the relief is less regular, the mountain-ranges more closely crowded together, and the parallelism far less pronounced than in the east. In the former quarter meridional ranges, or at any rate vast ramifying ranges, are not rare; but such ranges are practically absent in the northern and central parts of eastern Tibet. In respect of the more or less great regularity in the surface forms, the highlands of Tibet, notwithstanding the great diversity in materials and causes, may be compared with the lowlands of East Turkestan. In the latter we find that the dune-accumulations are extraordinarily regular in the east, while in the west that regularity practically ceases, and we have a chaos of dunes disposed in every direction. In the former precisely the same observation holds good of the mountain-ranges. Wellby's journey across Tibet from west to east affords a valuable proof of this. In proportion as he advanced towards the

east the more individualized and the more connected became the ranges, and the easier it grew for him to advance along the latitudinal valley which he was travelling in. A map of Tibet showing nothing but the lakes and rivers would alone be sufficient to suggest to us the regional difference in the configuration of the country. In the parts of Tibet which I and others have explored the lakes stretch almost without exception east and west, whereas the lakes in western Tibet are more irregular in shape, and stretch quite as often north and south as they do east and west. Even in the central lacustrine region, in which Nain Singh made his important discoveries, the lakes are distinguished by their irregularity of outline, although the two largest of them, the Tengri-nor and the Selling-tso, incline to stretch east and west. With regard to those parts of Tibet which have not yet been visited, it may fairly be assumed that, at any rate towards the north, they lie in respect of relief and character intermediate between the regions that border them on the east and those that bòrder them on the west. But for the country between Nain Singh's route and the Tsangpo we possess no data whatever, even if we follow Wegener and Grenard and assume, with tolerable certainty, that there exists in that region a vast main range, parallel with the Himalaya, and flanked by several minor parallel ranges, and assume further that there are river valleys and lakes between them.

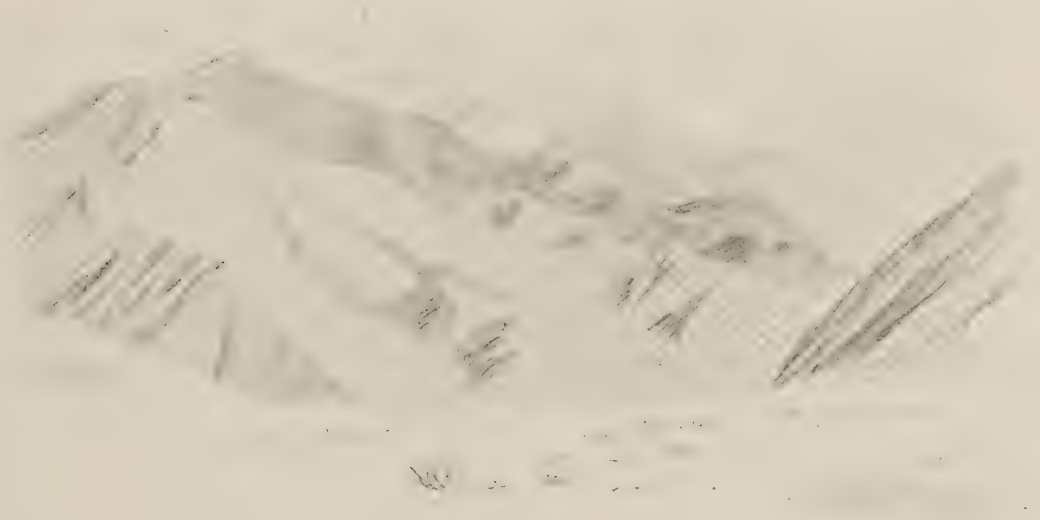


Fig. 356. THE ARPA VALLEY; LOOKING SOUTH.

It is not merely the recollection of the deficiencies that are still incidental to our knowledge of Tibet which has prevented me from carrying out my original plan of making an accurate analysis of its orography, but other reasons of a practical nature have also weighed with me. Before I were in a position to carry out my purpose, I ought to have at my disposal the whole of my own cartographical materials properly worked up; but at the moment of writing Major Byström and Lieut. Kjellström have not yet finished their labours. And I am even farther off

from what is the most important of all, namely the general map on the scale of 1 : 1,000,000, on which every well-known itinerary that has hitherto been made across Tibet will be traced. It is self-evident, that with such a map to help one, it would be far easier to follow the course of the mountain-ranges than by instituting provisional comparisons between the maps of the different explorers. And yet one other practical reason! I intend within a month or two to start upon a fresh journey to the unknown parts of Tibet, during the course of which I hope to be able to fill up many of the more serious gaps that now confront us. In view of this, it will be better to postpone my critical and final analysis until after my return home from my new journey, when the result cannot fail to be at all events invested with greater thoroughness and completeness. What I have to say in the following pages must therefore be regarded as merely a preliminary attempt or sketch of a characteristic,

Fig. 357. LOOKING SE FROM BOGHANA; NORTHERN FOOT OF KWEN-LUN MOUNTAINS.

and in this I shall confine myself principally to a consideration of the eastern half of the highlands of Tibet that possess internal drainage, namely the region between 31° and 39° N. lat. and 86° and 92° E. long. It is within these limits that the greater part of my own Tibetan journeys fall, and it is within their confines that the most important journeys of other travellers have lain. In default of the big general map of Tibet, I have had prepared a provisional substitute on the same scale of 1 : 1,000,000, showing my own journeys, and on the same sheet I have myself plotted the requisite routes, namely those of Prschevalskij, the Pjevtsoff expedition, Carey, Wellby, Bower, Rockhill, Bonvalot, Dutreuil de Rhins, and Littledale. The three expeditions mentioned first, fall however to such a small extent within the region of internal drainage as I have just defined it that they are of very little real use to us, except that they help us to follow more easily the course of the mountain-ranges. On the extreme south, again, the region is touched to only a very slight extent by Nain Singh's route. The map which I have

thus constructed can only be called a provisional one for the additional reason that I have had neither time nor opportunity to make the requisite corrections in the itineraries, and remove the errors which unavoidably cling to some of them. One of Bonvalot's lakes comes, for example, too close to one of my mountain-ranges; in Littledale the mouth of the Satschu-tsangpo lies about $^1/_4°$ too far to the east; and Bower's itinerary in the vicinity of the Addan-tso and the Naktsong-tso is not in perfect agreement with the real situation of those lakes. All these errors can only be reconciled with one another when the whole of the materials have been dealt with by an expert cartographer, and this task will be undertaken, after the completion of the principal map, by the institute of Justus Perthes, of whose cooperation I have been kindly assured.

Errors in longitude are of course the most likely to occur, together with errors in the distances between the several meridional routes. But seeing that our immediate object is to try and trace the latitudinal mountain-ranges with the help of meridional routes, the errors in question are not of the greatest importance. But notwithstanding that I have the assistance of six meridional routes on my map, all drawn pretty close to one another, it has proved anything but an easy task to trace the ranges which are crossed by them all. Even though it is evident that Bonvalot, Dutreuil de Rhins, Littledale, and myself on three separate routes have crossed over six different passes situated in precisely the same latitude or approximately the same latitude, that does not at all prove that all these passes are of necessity situated in one and the same continuous mountain-chain. For if the ranges just at that spot have a west-north-west to east-south-east direction, the six passes, just because they are situated on the same latitude, evidently belong to six different ranges. Equally too can the range which is crossed by any one of the six passes taper away in both directions without having any direct connection with the ranges that are crossed by the two nearest passes. Moreover it is quite safe to assume, that one and the same east-west range varies much in altitude at different longitudes. Suppose that Bonvalot, for instance, has crossed over one of these ranges by a very high pass, he involuntarily carries away the impression that that particular range must be one of the very loftiest in the interior of Tibet, and he indicates it as such on his map, making it blacker than all the other ranges in that same region, and finally he confers upon it a resounding name. In one or two places my itinerary runs at the distance of half a degree from Bonvalot's, and consequently there exists every reason to suppose that in the same latitude as that in which he crossed over the pass mentioned I too should encounter a high pass; but what I in reality find are merely low swellings. On the other hand I do find, say, a lofty pass at some distance farther south, which inevitably causes doubts to arise whether the last-named range is to be considered as a direct continuation of Bonvalot's; that is to say, it becomes doubtful whether the range has a prevalently north-west and south-east direction or whether the low pass lying on the same latitude as Bonvalot's high pass belongs to an east-west range which chances to be lower at the point where I crossed over it than where Bonvalot did.

In consequence of all this no small degree of uncertainty necessarily attends the construction of an orographical map, even of those parts of eastern Tibet in

which travellers' routes do run relatively close together. Yet had we possessed no other material than the meridional routes, this uncertainty would have been greater still than it actually is. But fortunately for the northern half of the region in question we have the advantage of two latitudinal routes; in its middle portion also two, though it is true short ones, running from north-west to south-east; while in the south we are fortunate enough to have quite a »faggot» of latitudinal routes. Confining our attention in the meantime to the first mentioned, namely my route of 1896 and Wellby's of the same year, we have in them a fixed and incontrovertible basis for determining the direction in which the mountain-ranges run. These two routes in the part of Tibet with which we are at present dealing are situated between 35° and 36° N. lat., and follow throughout the whole of their extent vast latitudinal

Fig. 358. VALLEY OF THE HATTAR-GOL IN TSAJDAM.

valleys lying between equally vast main ranges, and the said ranges run as nearly as possible from west to east. The range, or rather system of ranges, north of my route is the Arka-tagh, and the system of ranges between my route and Wellby's is the Koko-schili, or at all events the westward continuation of the range which bears that Mongol name. The position and direction of these two mountain-systems being fixed, we might therefore reasonably consider it probable that the ranges which lie next to them on the south run on the whole parallel to them, or at the most deviate but slightly from the direction which they pursue. Nevertheless this does not appear to be altogether the case, for my route of 1900 does not cross any pass worth speaking about between Camp XLVIII and Camp LVI, any more than my 1901 route does between Camps XXXIII and XXXVIII; instead of that we travelled along the latitudinal valleys between the mountain-ranges, which in the region defined appear to have rather a north-west and south-east direction. In other words the mountain-ranges in this region seem to diverge towards the east, and they are moreover less distinct and less continuous than in the country to the north of them. Taking now another step farther south, we come to a vast, compact range, a true dominating main range of the first magnitude, namely that

which I crossed over near Camp XLI (1901) by a pass 5,468 m. above sea-level, and this is a range which recurs on other meridional routes. South of that range the configuration again grows less regular: instead of broad latitudinal valleys running between distinct mountain-ranges we have a vast number of less regularly formed mountains, in which, though the east-west direction does indeed prevail, it is nevertheless less sharply accentuated. When we enter on the map those portions of the course of the Satschu-tsangpo that are known, that is to say those parts of it which have been touched by Bonvalot, Rockhill, Bower, de Rhins, Littledale, and myself, we see that that river flows from the east-north-east to the west-south-west, and if its valley is to be ranked as a latitudinal valley, it would seem to prescribe an east-north-east and west-south-west direction to the mountain-ranges. Now this inference is contradicted by Grenard's orographical map; but according to Rockhill's map the upper Satschu-tsangpo does appear to flow in a latitudinal valley.

Finally, in the extreme south of the region which we are considering, we have found that the ranges there exhibit a very distinctly emphasised east-west main direction and parallelism, a direction that is best defined by the arrangement of the hydrographical chain — Selling-tso, Jagju-rapga, Tschargut-tso, Addan-tso, Dagtse-tso, and Bogtsang-tsangpo. South of that and throughout the whole of the way to the Panggong-tso we were accompanied by an especially important range, though sometimes low or broken; this appears to form a water-divide between the recently mentioned basins and those that were discovered by Nain Singh. This range exhibits also a striking parallelism with one or two other physico-geographical main features with which we are already familiar, namely with the *thalweg* of the Tsangpo, which is of course a true latitudinal valley, and with the Himalayan system, which forms the southern margin of the Tibetan swelling. There a more pronounced north-west to south-east direction is assumed by the ranges and their latitudinal valleys, which are connected with the surface folding of the Tibetan highlands; for while in the extreme west the ranges are, as it were, squeezed close together, in the east they diverge more and more from one another.

When in the future Tibet shall have been traversed in all directions, the general maps of the country will unquestionably show some especially imposing and dominating ranges, with regard to which we possess at the present time only the most imperfect knowledge, or which we know only very fragmentarily. One of these is the range which probably forms the westward continuation of the range with the 5468 m. high pass north of Camp XLI (1901), and which, again probably, makes a connecting link between the Tang-la in the east and the Kara-korum in the west. Another circumstance eloquent of the existence of such a range, which might indeed be regarded as the true backbone of the Tibetan highlands, is, that in the faggot of Tibetan ranges this particular range really does occupy a median position in relation to the Kwen-lun and the Himalaya and all the other mountain-ranges.

In the unknown region of the south, that is to say in the country immediately north of the valley of the Tsangpo, we likewise have reason to suppose the existence of an important mountain-range, one part of which is the Nin-tscheng-tang-la on the southern shore of the Tengri-nor; and the same important range we find again also in the west, namely in the Alung-gangri swelling. These two sections would, it is

true, not be sufficient to warrant us in positing the existence of a continuous range; but we are also justified in presupposing, almost of necessity, the existence of at least *one* important water-dividing ridge between Nain Singh's lakes and the Tsangpo. We may further take it that the most north-easterly of the head-feeders of the Indus likewise gathers its waters out of this unknown and mysterious range.

Seeing now that our knowledge of Tibet is so defective, it would be, as the reader will readily see, and as I have already mentioned, a rather thankless task, to seek to unravel its vast concourse of mountains: although the attempt itself would perhaps not be without its interest, the result would be practically worthless. On my general map on the scale of 1 : 1,000,000 I have considered it inadvisable to enter anything except absolute facts, *i. e.* the fragments of the various ranges which have been visited by different travellers, paying no regard to the mutual connections of the ranges themselves either to east or to west. In this respect the map will afford ample opportunity to the speculative ingenuity of geographers, but it will be documentary evidence of the state of our existing knowledge about the mountains of Tibet. However the time will come when it will be completed by fresh itineraries, and then the several fragmentary sections will be linked together into continuous ranges and the dubious patches will grow smaller and smaller in area, until finally they disappear altogether. The geological structure, of which we have as yet but the faintest idea, will likewise in due time be elucidated, and simultaneously therewith the structural conformation of Tibet will be scientifically explained. Had all the travellers who have traversed eastern Tibet meridionally carried with them specimens of rock from the various ranges which they have crossed over, we should possibly have thereby been put in possession of an additional means of disentangling the mutual relations of the several ranges and consequently their connections one with another.

Still for those who have travelled through Tibet it will not be difficult to form an idea of what the map will look like which some day will represent the mountains of that part of the world with the same accuracy as the maps do, for instance, the mountains of Persia, the Tien-schan, or the Nan-schan. Upon studying the admirable new map of »Innerasien» in *Stieler's Handatlas* we see that the mountains in the west of the country, between 74° and 79° E. long., are fairly well known, and there appear no white patches at all, but the map is entirely covered with the differential signs of surface features. This will eventually be the case too with the middle and eastern parts: there too there will some day be no white patches left, but they will be filled with the conventional representations of mountains, valleys, lakes, and rivers. It is the very fact of there being so many white patches on the map in question which forces upon one *nolens volens* the impression, that the whole of the interior of Tibet is practically a flat plateau country, stretching from the Kwen-lun to the Himalaya, and it is easy to forget, that this is due simply to the fact that the great *lacunæ* have not yet been filled up. It is also conceivable, that our future map of Tibet will not only be an object of beauty to the eye, but will also present an astonishing picture of a fantastic and sublime reality — the gigantic mountain-ranges which stretch across that country, with the minor ranges lying between them. The relief will stand out sharply and boldly in the east and west, where lie the deeply trenched valleys of

the Indus and the Jarkent-darja on the one side and those of the Indo-Chinese rivers on the other; to north and south, where rise the border-ranges, there will appear a similar energetic modelling of the surface; and in the middle, though somewhat nearer to the northern than to the southern margin, the relief will be less powerfully sculptured. In a word, the whole will make up a picture from which it will be possible to read off directly several of the laws of denudation and erosion which for countless millennia have been actively at work shaping the Tibetan swelling into the actual surface-forms which it exhibits to-day.

The attempt to represent the Tibetan ranges which I myself am acquainted with — the task which I will now essay — is, as I have already said, entirely of a provisional character. The representation would have been both more certain and more trustworthy had my map on the scale of 1 : 1,000,000, making use of the whole of the materials, been ready. My attempt must therefore be regarded only as a »first edition», the improved and enlarged edition of which will appear in conjunction with the work which I trust I shall be able to write about my next journey in Tibet.

Fig. 359. TERRACES AT BORASAN IN EAST TURKESTAN (CHOTAN).

To begin with, we have the highlands of Tibet bordered on the north by a vast system of parallel border-ranges, bearing the common name of Kwen-lun. Of these the only part with which we are more immediately concerned is that which is called the Astin-tagh. Now the Astin-tagh undoubtedly forms a link in this chain of border-ranges; but orographically it cannot be said to be in direct connection with the main range of the western Kwen-lun. According to Grenard's conception, this last is continued eastwards by the Kalta-alaghan and other parallel branches, while the Arka-tagh forms the eastward continuation of a more southerly arm of the Kwen-lun. This interpretation is fully shared by Bogdanovitsch, as appears from the little sketch-map in his book (p. 83) dealing with the Pjevtsoff expedition. I too am of this opinion, though it must at the same time be acknowledged that the country around Tokus-davan, where the Kalta-alaghan and the Arka-tagh systems both begin, is far too little known to warrant sound conclusions being drawn as to the connection and relations of these ranges with the western Kwen-lun. If however

the Arka-tagh and Kalta-alaghan do form the eastward continuation of the Kwen-lun proper, then the Astin-tagh may appropriately be regarded as the westward continuation of the Nan-schan, though this last is so intimately united with the Kwen-lun that it appears to run continuously with the northernmost border-range of that system, the range, I mean, which is pierced by some of the streams that make their way down into the Tarim basin.

Fig. 360. VIEW FROM THE NORTHERN FOOT OF THE KWEN-LUN MOUNTAINS.

The two highest parallel border-ranges of the Kwen-lun proper form an immediate continuation of the border-range of the Pamirs. The existence of those two ranges has been ascertained at several points by several travellers. On the Karakorum route the southern range is crossed by the Suget-davan (5434 m.) and the northern range by the Sandschu-davan (4977 m.). Grenard counts the Suget-davan as belonging to the Altyn-tagh (Astin-tagh) and the Sandschu-davan to the »Chaîne du Kilian». To the former he gives an altitude of 5260 m. and to the latter of 5040 m. South of Pulur he mentions the Kisil-davan (5156 m.) as being situated in the »Altyn Tagh postérieur» and names also the »Col Kouk Bouyan» (5700 m.) in the »Oustoun Tagh» beside the gorge of the Kerija-darja. In the same »Altyn Tagh postérieur» he speaks of a nameless pass with an altitude of 5440 m., and situated close to Sarik-tus, south-east of Sourghak. In the region of the upper Nija-darja Grenard distinguishes no less than six parallel ranges belonging to the Kwen-lun system, and calls them the Aldy Tagh (Aldi-tagh = the Anterior Mountains), Altyn Tagh antérieur, Altyn Tagh moyen, Altyn Tagh postérieur, Oustoun Tagh antérieur, and Oustoun Tagh postérieur respectively.

Farther east, immediately west of the breach made by the Tschertschen-darja, the French expedition crossed over the Astin-tagh by the pass of »Zarchou» (Sarschu-davan) at an altitude of 4780 m. There too the Lower Astin-tagh is pierced by the Tschertschen-darja. Thus Grenard has transferred to the Kwen-lun proper the designations »Altyn Tagh» and »Oustoun Tagh» (Astin-tagh and Ustun-tagh) which

belong more appropriately to the mountainous country south of the Kara-koschun. But the procedure is quite justified, if we confine our attention to the fact that both pairs of ranges are border-ranges.

The members of the Pjevtsoff expedition made excursions from Kara-saj up on the Tibetan plateau and crossed over the southern main range of the Kwen-lun by an unnamed pass with an altitude of 5058 m., situated immediately south of Dasch-köl; the lower range is there cut through by the Bostan-toghrak. The upper range was also crossed somewhat farther west by a pass of 5274 m. immediately south of Hangeit-köl. According to Bogdanovitsch the westward continuation of the range that lies south of the Dasch-köl is called the »Usu-tagh», probably a corruption of Ustun-tagh, »the Upper Mountains». When travelling south-west from Kara-saj Deasy crossed over the pass of Atisch (5030 m.), situated in a latitudinal valley between the Upper and the Lower Astin-tagh and not far from Schor-köl, and due south from Pulur he mentions the pass of At-to (5060 m.), which appears to belong to the upper main range. The lakes Schor-köl, Hangeit-köl, and Dasch-köl are clearly situated in the big latitudinal valley between the two main ranges. And it is an equally indubitable fact, that both these ranges are continued westwards by the two ranges in which are situated the pass of Suget-davan and the pass of Sand-schu-davan.

Whatever may be the real facts with regard to the ranges in the vicinity of Tokus-davan, this much is at any rate certain, that in precisely that region and for some distance farther west the two main ranges of the Kwen-lun system break up into several chains that diverge like the fingers of the human hand. Nevertheless the orographical relations here, at the western margin of the part of Tibet which lies north of the Arka-tagh, are far from being clear. According to Bogdanovitsch, the various mountain sections Tokus-davan, Musluk (with the pass of the same name at an alt of 4710 m.), the Moskovskij range, and the Tschimen-tagh form properly one single long-extended range, in which is also situated Preschevalskij's Mt Kreml. I crossed over this identical system on 6th October 1900 by a pass (5143 m.) north-west of the Atschik-köl. Possibly Bogdanovitsch's conception is on the whole correct, although to me it appears more probable that the range which lies north of the Atschik-köl basin dwindles away entirely towards the east, and that the Kalta-alaghan and Tschimen-tagh merge westwards into the parallel ranges that lie north of the Tokus-davan and Musluk-tagh. But the orographical relations of this region can only be cleared up by detailed study on the spot; the *data* which we as yet possess are too few to allow of safe conclusions being drawn.

The section of the Astin-tagh that is situated between the Tschertschen-darja and the Dschahan-saj is also but little known. In this stretch the system has been crossed at only one point, namely by myself in 1901, when I used the gorge of the Tscharklik-su. We may however assume that the Astin-tagh consists there, as it does farther east, of two parallel ranges, and of these the lower range is pierced by the river just mentioned, while the upper range is crossed by an unnamed pass at an altitude of 2944 m. The pass of Jaman-davan (3136 m.), on the other hand, is situated in a secondary spur. In the mountainous country south of the source-region of the Tscharklik-su I crossed over several other passes, most of them of a secondary

character, though two of them are main passes, with altitudes of 3797 and 4079 m. respectively, belonging to the westward prolongations of the Akato system.

In the source-regions of the Kara-muran I had again to cross over two main passes in order to reach that part of the North Tibetan plateau which is situated north of the Arka-tagh. These were the Dalai-kurghan-art (4357 m.), situated in the range that corresponds to the Lower Astin-tagh, and the Japkaklik-davan (4741 m.), in the range that corresponds to the Upper Astin-tagh. Thus here again the border montanic system is double, just as it is all the way westwards to Pamir.

The part of the middle Tschertschen-darja which flows towards the west and is bounded on the south by the Tokus-davan and the Musluk-tagh and on the north by the western portion of the Astin-tagh proper, flows unquestionably through a true latitudinal valley, of equivalent rank with the Tschimen valley and the great latitudinal valleys up on the Tibetan plateau, although it is essentially differentiated from them by its terminating in the lowland basin of the Tarim. Nevertheless it is difficult to make out how the Astin-tagh ends over against this valley. Possibly one of the twin ranges may be pierced by the latter; and support is lent to this supposition by the circumstance, that the travellers who have crossed over the extreme western tip of the Astin-tagh proper, in the elbow of the Tschertschen-darja itself, speak only of one pass, namely the Tschoka-davan, which according to Pjevtsoff reaches an altitude of 2906 m. De Rhins too crossed over this pass, but he gives it no altitude, any more than Littledale does, though the latter calls it the Chokur Pass. Indeed on Littledale's map we find the altitudes of his camps only, but more rarely the altitudes of the passes, though these are of course much more important. Nevertheless the existence of only *one* pass along this route seems to suggest that one of the two Astin-tagh ranges has terminated, or perhaps more correctly has been broken through, before it reaches the latitudinal valley of the Tschertschen-darja.

Advancing yet another stage towards the east, we come to regions that are comparatively well known, and there I move with a feeling of far greater certainty, because I have crossed them in several places. These regions will also show very distinctly on my general map of Tibet (scale 1 : 1,000,000); and of the general structure and configuration of this portion of the country at all events it will be possible to obtain a clear idea. I had indeed intended entering here more into detail, as I have in fact pledged myself to do in the preceding pages; but such detailed recapitulation appears to be in the meantime superfluous, and not least so for the reason that the study of my geological material is not yet completed. In the meantime I will therefore content myself with a brief general statement.

We have ascertained, then, that that part of the Astin-tagh which lies south from the Kara-koschun is a double range and farther east splits up into several chains, running in sharply accentuated parallel directions. Immediately east of the Dschahan-saj there is a mountain-road, which has been used by several travellers, and which crosses over the twin ranges in the passes of Kum-davan and Tasch-davan respectively, the former having according to Carey an altitude of 3262 m. and the latter of 3963 m. This route was also used by Bonvalot; but that traveller gives no altitude for the Kum-davan, though he puts the Tasch-davan at 5200. According to Pjevtsoff the last mentioned pass only reaches 3808 m. I my-

self crossed those same two ranges on the Tatlik-bulak route, north of Usun-schor; there the Lower Astin-tagh is breached by the river of Basch-kurghan and the altitude at the beginning of the breach amounts to 2629 m. The Upper Astin-tagh I crossed by an unnamed pass at 3588 m.; though according to Prschevalskij its altitude is 3384 m. From that point and right away to the districts in which I visited the Astin-tagh in the winter of 1900—01 that range is practically quite unknown, nor has Littledale's journey served to explain its structure. In the stretch between my Camp CVIII and Camp CIX the Astin-tagh system is divided into at least three parallel ranges, and in just that quarter I crossed over the middle range by a pass

Fig. 361. VIEW LOOKING UP THE VALLEY FROM TATLIK-BULAK.

3247 m. high, and the lowest range at Camp CIX by a pass 2915 m. high. North of this range there exist yet one or two subordinate chains, which may fairly be regarded as foot-hills, and are certainly broken in several places. From Kan-ambal, which itself has an altitude of 2878 m., we descended northwards through the glen of the Anambaruin-gol, a glen which manifestly breaks through the Lower Astin-tagh. The pass east-north-east of Kan-ambal, which reaches an altitude of 3095 m., may be considered as belonging in all probability to the Lower Astin-tagh. The Anambaruin-ula I regard as a vast swelling of the Astin-tagh; it consists of at least three parallel ranges. East of that we crossed over the system by a single pass, namely Scho-ovo-tu with an altitude of 3667 m. On Roborovskij's map we find in this locality a pass with an altitude of 3713 m., which is probably identical with my pass. That the system is in this part restricted to a single chain may be due to the accidental circumstance that the stream of the Scho-ovo-tu possibly cuts its

way through the Lower Astin-tagh. But at no great distance east of that point the range again appears to be double; it is so represented on the map appended to Prschevalskij's *Third Journey* (1879—80). It is the more southerly of these two ranges which he has called after Humboldt and which he crossed over by a pass 4024 m. high. Yet one stage farther towards the east the Astin-tagh merges into the Nan-schan, a mountain-system that lies entirely outside of the area we are considering. I would only call to mind, that the Astin-tagh is the one solitary range of the North Tibetan system which continues eastwards on the *north* side of the Tsajdam depression, whereas all the rest either terminate at its western edge or run along the southern side of the basin.

Let us throw together into one table the passes from west to east which we have just been considering. We then obtain the following altitudes for those passes which we regard as belonging to the upper border-range of the Kwen-lun system, the question of the orographical connection of the Astin-tagh with the Kwen-lun proper being meanwhile disregarded.

Suget-davan	5434 m.
At-to-davan	5060 »
Pass S. of the Hangeit-köl	5274 »
Pass S. of the Daschi-köl	5058 »
Japkaklik-davan	4741 »
Sarschu-davan	4780 »
Pass beside the upper Tscharklik-su	2944 »
Tasch-davan	3963 »
Pass S. of Basch-jol	3588 »
Pass in Eastern Astin-tagh	3247 »

For the lower border-range we have the following altitudes: —

Sandschu-davan	4977 m.
Dalai-kurghan-art	4357 »
Tschoka-davan	2906 »
Kum-davan	3262 »
Pass at Lap-schi-tschen	2915 »

From this we may deduce the general rule, that notwithstanding one or two exceptions in the above list, the passes in the border-ranges of the Tibetan swelling decrease in altitude from west to east. The various passes are however in every way mutually comparable, for most of them are used by caravans or hunters, and all of them are known to the natives. Now it is evident that for the purposes of communication the lowest and easiest passes will be selected, and it is equally evident, that a catalogue of all the existing passes (supposing it indeed possible to draw one up) would contain a very great number that are higher than the known passes, but on the contrary very few or none at all that are lower.

It would serve no real purpose, from the altitudes of the passes enumerated above to calculate an average pass altitude for these twin border-ranges, because their

orographical connection is so doubtful. Confining our attention to the particular fact, that these ranges lie farthest north of all the border-ranges of Tibet, it will be sufficient in the meantime to bear in mind, that they actually do decrease in altitude from west to east. And if we look at the purely mechanical aspects of the case, it is evident that the altitudes must be greatest in that part of this vast upswelling of the earth's surface in which the folding and side-pressure have been most powerfully and most energetically exerted, and that is in the extreme west. If now we disregard the many different geological ages of the various mountain-ranges, the varying degrees of denudation activity in different parts of Tibet, the unequal distribution of the rainfall, with its attendant more or less powerful erosion — if in a word, we disregard several intrinsically important factors the investigation of which would require study in many directions extending over several decennia, and confine our attention solely to the *mass*, that is to say the cubic contents of that part of the earth's crust which, duly uplifted and pressed together, finally resulted in the protuberance of the solid body of the earth which forms what we now call the Tibetan highlands, and which we may suppose was originally quadrilateral in shape, we find that this mass or stupendous segment of the earth's crust has been more intensively and more energetically pressed together in the west than in the east. In the west along the route from Srinagar to Jarkent, for instance, the breadth of the swelling is only about two-fifths of what it is between Kara-koschun and Sikkim. If we assume that the mass in the east was originally equal to the mass in the west, it is manifest that the ranges in the latter quarter must be now both higher and more closely compressed together than in the former, and such is indeed actually the case. I do not of course pretend that this theoretical view of the course of events agrees in all particulars with the actual occurrences. It may well be probable, that the latitudinal valleys in the west are in general only two-fifths as broad as they are in the east, but on the other hand it would be absurd to suppose either that the mean altitude of the crests of the ranges in the west, or that the mass of those same western ranges, as compared with those in the east, is as 5 to 2, particularly as such a statement would run directly contrary to all experience. We have also to take into account the effects produced by all the factors which I recently put aside. The interior of Tibet may be looked upon as rigid and immovable; but in the younger border-ranges mountain-building is still going on, and there too the counter-agency of erosion is most actively at work. It is precisely in virtue of the relatively vigorous activity now operative in the Himalaya, that that mountain-system occupies such an exceptional position in relation to Tibet, and it is in the eastern part of the Himalaya that we find its loftiest summits.

It is impossible to say anything with regard to the absolute altitudes, proceeding from west to east, in the mountain-ranges that run right across Tibet. Are they as a rule lower in the direction indicated, as we should indeed expect from the observations which I have just made, or are they altogether irregular? This question can only be answered when the ranges in question have been mapped and traversed along several lines. At the present moment it is impossible with any degree of certainty to give an answer to the above question, even for the region embraced between 31° and 39° N. lat. and 86° and 92° E. long.; for even though

the meridional routes do lie relatively close to one another, we are not warranted without further criticism in comparing together the absolute altitudes of the various travellers, because some of them determined their altitudes by means of good and reliable instruments, while others have been content to rely upon one or perhaps two aneroids, and in calculating the results obtained have not given themselves the trouble to eliminate as far as possible all the ordinary sources of error. Whereas one traveller has neglected the highly important opportunity of determining the heights of every pass he crossed over, the altitudes obtained by another are in many cases extremely improbable. This is in fact the case with Bonvalot's altitudes, which are palpably too high all through.

It is however hardly probable that each and every one of the ranges in the interior of Tibet does as a rule decrease in altitude from west to east. It is not conceivable that the passes in the imposing range, for example, which I crossed over at the height of 5462 m. north of Camp XLI (1901), increase in altitude towards the west. *If* that range really does continue the whole way towards the west and connects with the Kara-korum range, it is indeed true that a rise may be observed when we compare the pass in question with the Kara-korum pass, but then the rise is only slight and the fact may be due solely to accidental local circumstances.

To attempt, on the basis of the data that we possess, to estimate the mean altitudes of the different ranges is also a difficult task. If we consider the Astin-tagh proper, that is to say the section between the bend of the Tschertschen-darja and the western flank of the Anambaruin-ula, we obtain a mean pass altitude for the Lower Astin-tagh of 3028 m. and for the Upper Astin-tagh of 3435 m.

CHAPTER XXXVII.

OTHER PARALLEL RANGES OF NORTHERN TIBET.

In what follows I shall endeavour to deal in the same way with the remaining ranges of Tibet. The Astin-tagh is separated from the next range on the south, namely the Akato-tagh, by a broad latitudinal valley which continues all the way to Anambar-ula. The Akato-tagh I crossed over five times, the passes by which I did so being in two cases so close together that, upon a comparison with the othe

Fig. 362. LATITUDINAL VALLEY OF ARKA-TAGH.

passes in the same range, they ought to be regarded as one: I mean the low and easy saddle which lies south-east of Usun-schor, where I obtained readings of 3208 and 3154 m. Let us take the mean of these two altitudes, and put the height of the saddle at 3181 m. The nearest pass to this on the west, by which we crossed over the range again, is the Ghopur-alik, 4926 m. high, and still farther west lies the pass between Camps VIII and IX (1901), with an altitude of 4079 m. In the

extreme east we crossed by the Akato pass, situated north of the Ghas-köl and reaching an altitude of 3698 m. These four passes lie relatively close to one another, namely within a space of $2^1/_2°$. They do not indicate any drooping of the range towards the east, but on the contrary prove that its crest is very irregular in altitude. In the Ghopur-alik we have a pass which in point of elevation very considerably surpasses the mean altitudes of the passes in the parallel ranges that come next to it on the south. The four passes which I have mentioned give for the Akato-tagh a mean pass-altitude of 3971 m., thus a considerably higher value than for the Upper Astin-tagh.

Fig. 363. THE PITELIK-DARJA.

Both the Astin-tagh and the Akato-tagh run from west-south-west to east-north-east. Of the latitudinal valley between them I have only two reliable altitudes, namely 3081 m. and 2860 m., giving a mean elevation of 2970 m.

The next range to the south is the Tschimen-tagh, with five reliable pass-altitudes, namely, going from west to east, — 4159, 4194, 4034, 4545, and 4269 m. These determinations give, as compared with the Akato-tagh, a fairly level crest, the differences in elevation not exceeding 500 m., whereas in the Akato-tagh they amount to 1750 m. Thus the mean pass-altitude of the Tschimen-tagh is 4240 m. The Tschimen-tagh in its western part runs from west to east, but in its eastern part it inclines towards the east-south-east and south-east. The Akato-tagh is separated from the Tschimen-tagh by the Tschimen valley, which is uncommonly broad and distinctly defined: according to Pjevtsoff, it begins at the pass of Ghultscha-davan, which forms a water-divide between the Tschertschen-darja (Tarim basin) and the Tschimen valley (Tsajdam). From that pass this latter valley slopes steadily down to the Ghas-köl. According to Pjevtsoff, the Gultscha-davan has an altitude of 4314 m.; and according to my own observations, the Ghas-köl lies at an altitude of 2837 m. In the Tschimen

valley I encamped in fifteen different places counting from the mouth of the Toghri-saj, and consequently have excellent material for calculating its mean elevation; and yet other encampments were so close to the foot of the mountains that they may conveniently be neglected. I also exclude that part of the valley which stretches from the mouth of the Toghri-saj to the Ghultscha-davan, partly because I never visited it, and partly because the ascent up to the pass is so steep that to include it would lead to an illegitimate increase in the mean elevation of the real flat and open valley. The altitudes of the fifteen encampments are as follows, counting from west to east: 3800, 3769, 3475, 3475, 3455, 3489, 3378, 3305, 2961, 2930, 2977,

Fig. 364. THE PITELIK-DARJA.

2907, 2899, 2865, and 2837 m. Thus the mean altitude of the Tschimen valley is 3237 m. Consequently its floor lies 200 m. higher than the pass-altitude of the Lower Astin-tagh and 200 m. lower than the pass-altitude of the Upper Astin-tagh. The pass of Ghultscha-davan is a threshold or water-divide in the latitudinal valley itself. Thus orographically the Tschimen valley is continued west of that pass and is there drained by the middle Tschertschen-darja. In virtue of this conformation — and with regard to this I depend solely and alone upon Pjevtsoff's information — the Tschimen valley may be regarded as a very important orographical boundary, converting the Akato-tagh and the Upper and Lower Astin-tagh into a separate mountain-system sharply distinct from the Tibetan highlands proper. Between this system and the highlands proper, which only begin on the south of the Arka-tagh, there intervenes a transitional region, namely the extensive inland-drainage area of the twin basins Kum-köl and Atschik-köl. It is only necessary to call to mind, that the Ghultscha-davan is the only latitudinal threshold in that region which divides the streams that flow westwards to East Turkestan from those that flow eastwards to

Tsajdam, in order to realise to the full its importance as an orographical boundary. And when we remember, further, that in the east the Tschimen-tagh is the first mountain-range which lies immediately south of this great depression, and that in the west the Tokus-davan and Musluk-tagh are also the first mountain-range which lies immediately south of the same depression, we have every reason to conclude that the Tokus-davan + Musluk-tagh and Tschimen-tagh form orographically one and the same continuous mountain-range, a range pierced in the west by the Tschertschen-darja and its tributaries, in the middle by the Toghri-saj, and in the east by the stream that enters the Tschimen valley over against Kara-tschoka. Under these circumstances the great branching range which borders the basin of the Atschik-köl on the north must be regarded either as a ramification of that system or — and this is perhaps more probable — as an independent parallel range, though it soon terminates indeed towards the east, unless we are prepared to recognise it again in one of the ranges through which the Pitelik-darja forces its way.

Let us now consider the Kalta-alaghan. Of this range I obtained five pass-altitudes — 4326, 4348, 4438, 4412, and 4786 m., going from west to east and proving that this range, contrary to the Astin-tagh, grows increasingly higher towards the east, where it gradually merges, as the Tschimen-tagh does, into the ranges that border the Tsajdam basin on the south. According to these five data, the mean pass-altitude of the Kalta-alaghan amounts to 4462 m. I have deliberately left out of account Prschevalskij's pass of Amban-aschkan, which is situated in this range, and which he puts at an altitude of 4268 m. This figure is consequently lower than any that I obtained, though not for that reason improbable. Bonvalot also crossed over by the same pass, though on his map he gives no altitude; but as he considers that the Kum-köl-darja lies at an elevation of 5550 m., and as according to Prschevalskij the pass lies 200 m. higher than the surface of the Lower Kum-köl, the Amban-aschkan would consequently in that case, accepting Bonvalot's computation, come to lie at about 5750 m., or exactly 1500 m. higher than it in reality does lie. In the light of these circumstances I am unable to place confidence in any other data than my own, namely the altitudes which have been calculated and corrected by Dr. Ekholm.

In the extreme east we discovered a quite short range thrust in between the Tschimen-tagh and the Kalta-alaghan, namely the Ara-tagh or the Middle Range, which we crossed over by a pass at 4373 m., and which soon tapers away and disappears in the west. On both sides of it are latitudinal valleys, which unite to form *one* valley at its western extremity. Of this main latitudinal valley, the extreme eastern part of which runs along the northern foot of the Ara-tagh, I took the following five observations of altitude. The first four succeed one another from east to west as far as the point below Möle-kojghan where the breach is made to Kara--tschoka, while the fifth was taken immediately above Kum-bulak, from which point the valley slopes down eastwards to the same breach. The first four altitudes are 4185, 3888, 3726, and 3594 respectively, and the fifth 4197 m. Taking the entire latitudinal valley, its mean altitude is consequently 3918 m. Of the latitudinal valley that lies south of the Ara-tagh I have only one measurement, namely 4301 m., and in order to get a mean value we must take the first measurement made after the

two valleys unite, namely 3888 m.; this gives a mean altitude of 4094 m. If we prefer to make a scrupulous comparison of its elevation with that of the latitudinal valley between the Tschimen-tagh and the Ara-tagh, we ought to restrict ourselves to the two altitudes 4185 and 3888 m., which give a mean of 4036 m. Thus the southern latitudinal valley of the Ara-tagh lies at all events a step higher than its northern valley.

South of the Kalta-alaghan we have a remarkably spacious latitudinal valley, which in respect of its morphology is very unlike the preceding; for it resembles rather a rounded or elliptical basin, with a slope towards the north. Nevertheless the deepest trough in this depression runs along the foot of the Kalta-alaghan, and beside it I took the altitudes 3922 m. (Camp XV, 1900), 3882 (Upper Kum-köl), 3878 (near the Kum-köl-darja), and 3867 m. (Lower Kum-köl). Putting these data together we obtain for the trough a mean altitude of 3887 m. If however we take into account other determinations of altitude, such as those from the southern ascending parts, we get a mean elevation of 4098 m. Nevertheless the important figure, which in comparison with preceding data shows a distinct descent, is the mean of 3887 m.

If now we proceed to the Arka-tagh and examine the observations of altitude which we possess of that system, we at once become aware that we have travelled a stage away from the regions in which we are quite sure of our facts. To attempt to explain the orographical structure of the Arka-tagh in a few words is indeed next to impossible. Between 86° and 90° E. long. this system has, it is true, been crossed over no less than seven times, namely, proceeding from west to east, by (1) myself in 1896, (2) Dutreuil de Rhins, (3) Littledale, (4) myself in September 1900, (5) myself again in 1901, (6) Bonvalot, and (7) myself in July 1900. And to these may be added in the far east of the range the point where I crossed over it on my way from Tibet to Tsajdam in 1896, Carey and Dalgleish's crossings in the same region, and lastly all the itineraries, briefly alluded to above *en passant*, which cross over the eastern continuation ranges of the Arka-tagh system to the south of the Tsajdam basin. In what follows I do not however take these itineraries into account, because between them and the foregoing, that is between my routes of July 1900 and September 1896 there exists a gap of the breadth of 3°, which is entirely unknown. In that stretch nobody has ever crossed over the Arka-tagh, and indeed it would seem that it is not altogether easy to get across it in that quarter. Whilst travelling between lake No. XX and the Ike-tsohan-gol I did, it is true, cross over two important passes, although in point of altitude they cannot be compared with the passes of the central Arka-tagh; still it is impossible to say in what relation those ranges stand to the parallel ranges of the real Arka-tagh. In default of exact explorations in that region we must rest content with taking it for granted that the Arka-tagh is connected with the ranges out of which the Naidschin-gol and the Schuga-gol issue, and which farther east form a water-divide between the Dscharing-nor and Oring-nor on the one hand and the Alang-gol and Bajin-gol on the other. Taking it in its widest interpretation, the Arka-tagh is thus a very extended system, possessing very different structures in its different parts, now forming a very sharply defined main crest with several smaller parallel ranges and now constituting

a system of crests of uniform height, amongst which it is difficult to determine which is the main crest. One characteristic feature of the system throughout is however this, that it actually does consist of various parallel chains and nowhere constitutes a single range, with spurs breaking obliquely away from it after the fashion shown on the map of the Russian General Staff.

Fig. 365. VALLEY NEAR CAMP XV, 1901.

When you look at a provisional general map on which all these seven routes are plotted, and if on each such route you enter the altitude and situation of every pass they respectively cross over, you would possibly be tempted at the first glance to thread together on one line all the highest passes, and say that these are the passes which are situated in the main range of the Arka-tagh. But that would be an entirely erroneous assumption; the direction of the Arka-tagh would in that case be incorrectly drawn, and *a priori* highly improbable, and all the more so because we know that certain latitudinal valleys in that region run in directions which point to entirely different conclusions. Although a certain pass on, say, route (4) is the highest on that route and attains an altitude of 5203 m., while the highest pass on route (6) has an altitude of 5450 m., it by no means follows that these two culminating passes are situated in identically the same mountain-range, and the improbability is increased when the latter pass is situated almost half adegree to the south of the former. By joining them together we should make the main range of the Arka-tagh run in a direction that in no wise corresponds with the direction of the adjacent latitudinal valleys, and it would be difficult to understand the connections between the passes farther north belonging to the several different routes. For while we have ascertained, that in that section the Arka-tagh does as a fact consist of several parallel ranges, it is abundantly clear that these various ranges may vary in altitude in different localities. On the other hand two

passes having altitudes of 5521 and 5042 m. respectively, although lying relatively close together, may actually belong to one and the same range, despite the fact that the difference of altitude between them is not less than 500 m.

On the basis of the routes I have mentioned, I believe I am able to identify four different ranges in the middle Arka-tagh, the one furthest north being the most uncertain; or possibly it ought rather to be regarded as being divided into two or more broken parallel ranges or foot-hills. But in the meantime let us take it as it is and make the best of it. In this range we have three passes at 5280, 4779, and 5005 m. respectively, giving a mean altitude of 5021 m. The »Col du Vent» of Bonvalot appears to be situated in this range, but he gives it no altitude. I also crossed this range through the gorge of the Toghri-saj, but of course in a transverse glen. Proceeding another step southwards, we come to the second range of the Arka-tagh (Arka-tagh II), with the following known passes, proceeding from west to east: — 5250, 5203, 5189, and 5130 m., giving a mean altitude of 5193 m. The second of these passes, which I crossed over on the 30th September 1900, in comparison with the passes which lie south of it on the same meridian, is so sharply defined that I do not hesitate to say, it is the main range of the Arka-tagh in which it is situated. And evidently Bonvalot's »Mts de Niatz» lie in the same range, though, as usual, he gives no altitudes, notwithstanding that this is the very place where they are particularly wanted.

In the next parallel range (Arka-tagh III) we have passes at 5436, 5080, 5203, 5450, and 5122 m., giving a mean pass-altitude of 5258 m. The fourth of these values is taken from Bonvalot, and to a slight extent impairs the trustworthiness of the mean altitude, which after this pass is excluded drops to 5210 m. Finally, in the southernmost range of the Arka-tagh (Arka-tagh IV) we have the following pass-elevations — 5519, 5521, 5116, 5042, and 5111 m. This is the range which I crossed over by the second of these passes in 1896, the altitude of the pass, 5521 m., being very close to that (5519 m.) which De Rhins gives for »the southern Kara-muran pass», situated immediately west of my pass.

This is the range the position of which can be most easily determined, for it is that which overlooks from the north the latitudinal valley down which I travelled in 1896. From the pass with an altitude of 5521 m. the surface slopes down to the bottom of the latitudinal valley at lake No. 1 (Camp XII) regularly and uninterruptedly, without crossing over any foot-hills. I also crossed over this great latitudinal valley at three other places, all lying east of that pass, and do not hesitate to say that the first pass on each of these three routes belongs to the same important range as that which we crossed over by the 5521 m. pass. Upon joining all these passes together, we find that the line so made runs perfectly parallel to my route down in the latitudinal valley, and that route followed, for convenience of marching, the lowest trough in the valley itself. The mean pass-altitude in this range amounts to 5262 m. Hence both the direction and the position of Arka-tagh IV may be regarded as fairly well established, and in point of fact it may be taken as affording a key or base for locating the other ranges that lie to the north of it. On my provisional map they are drawn as near as possible parallel with the key range.

Besides these four main ranges there occur between them several more or less short, broken ranges of secondary rank. But the determination of the mean altitudes of the latitudinal valleys that run between the four main ranges is on the other hand more difficult, partly because their character as true latitudinal valleys is frequently masked by these secondary ranges or by ramifications and spurs of the main ranges, and partly because the lowest altitudes measured between two main ranges along a given meridional route do not of necessity coincide with the actual bottom of the latitudinal valley, for the choice of a camping-ground was generally determined not by considerations of altitude, but by the presence of water and grazing. Let us however, subject to this warning, take the lowest values for the three latitudinal valleys separating the four main ranges; then in the valley which comes between Arka-tagh I and Arka-tagh II, and proceeding from west to east, we have the altitudes 4880, 4750, 4733, and 4719 m., giving a mean elevation of 4770 m.; in the valley which intervenes between Arka-tagh II and Arka-tagh III we have altitudes of 4878, 4984, 4948, 5069, 5050, and 4879 m., giving a mean elevation of 4968 m.; and in the third valley, between Arka-tagh III and Arka-tagh IV, we have 5055, 5086, 4980, and 5028 m., giving a mean altitude of 5037 m.

Fig. 366. VIEW FROM THE GLACIER-RIVER OF CAMP XXVIII, 1900.

With regard to the altitudes quoted above for the four parallel ranges of this system, it may be said, that as a rule each of them grows lower towards the east, though there are of course local exceptions. And that it must indeed be so is explained by the fact that the several meridional routes naturally seek to cross over the ranges at their lowest parts, and we may also take it for granted that between every pair of these routes there exists a more or less important swelling, each crest being often mantled with perpetual snow and glaciers. While one of these routes

may cross the range at a spot intermediate between two such swellings, the other may skirt the foot of one of them, and consequently cross by a higher pass than the former route. Nevertheless we may take it as a general rule, that in the region under consideration the pass-altitudes decrease somewhat towards the east; and probably this law would stand out with greater convincing force were we able to continue our investigations as far in an eastward direction as the Arka-tagh would admit of being followed.

When, on the other hand, we study the figures quoted for the three latitudinal valleys, we see that, while the law does indeed receive confirmation in the first of the three, although it is due to a purely accidental circumstance, yet in both the other two valleys the altitudes are very irregularly distributed; indeed in the case of the middle valley we ought rather to speak of a rise towards the east. These circumstances are connected with the general orographical structure of the Arka-tagh system. Since the system consists of parallel ranges, erosion is operative partly in the latitudinal valleys, partly in the transverse glens that break through the ranges. The Pitelik-darja, for example, cleaves a passage through two of the parallel ranges, but it owes its formation to streams that drain long stretches of the latitudinal valleys. In these valleys there exist, as there do everywhere on the Tibetan plateau, cross-ridges or thresholds, from which the water flows both east and west until it reaches a convenient transverse glen. Hence in one and the same latitudinal valley the absolute altitudes vary pretty considerably, and the difference of elevation between a cross-threshold and the entrance to a transverse glen may often amount to 200 or 300 m. This again is another reason why the altitudes which we possess, taken more or less at random, of these latitudinal valleys vary considerably and irregularly according as the various sites lie nearer to or farther away from a cross-threshold or a transverse glen.

As the result of the preceding inquiries we obtain the following mean pass-altitudes for the parallel ranges of northern Tibet and for the latitudinal valleys that lie betwen them: —

Lower Astin-tagh	3028 m.
Latitudinal valley	2799 m.
Upper Astin-tagh	3435 m.
Latitudinal valley	2970
Akato-tagh	3971 m.
Latitudinal valley of Tschimen	3237
Tschimen-tagh	4240 m.
Latitudinal valley	3918
Ara-tagh	4373 m.
Latitudinal valley	4094
Kalta-alaghan	4462 m.
Latitudinal valley of Kum-köl	3887
Arka-tagh I	5021 m.
Latitudinal valley	4770
Arka-tagh II	5193 m.

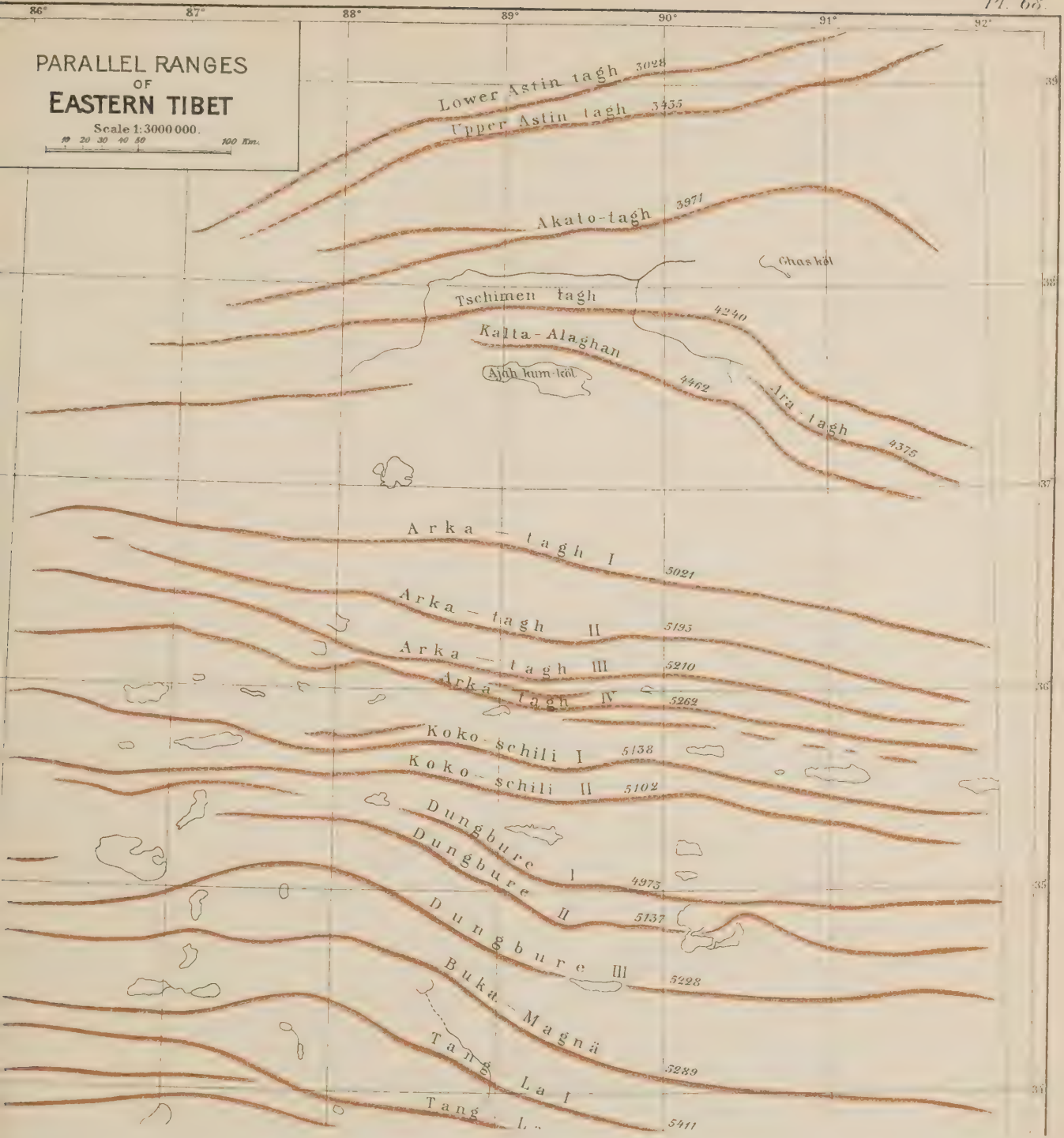
Latitudinal valley	4968 m.
Arka-tagh III	5210 m.
Latitudinal valley	5037 »
Arka-tagh IV	5262 m.

From this table we obtain conclusively the general law, that, within the region we are considering, the ten parallel ranges of Northern Tibet grow increasingly higher towards the south, that they rise as it were by steps or terraces up to the northern edge of the plateau-land proper. Proceeding from north to south the amounts by which each successive step ascends are as follows:

407	m.
536	»
269	»
133	»
89	»
559	
172	»
17	»
52	»

The difference between the altitude of the lowest, most northerly range, the Lower Astin-tagh, and the highest, most southerly of the Arka-tagh ranges thus amounts to 2234 m. The figures quoted above prove that there is a very considerable rise in the first three ranges: the Akato-tagh lies not less than 536 m. higher than the Upper Astin-tagh, which is itself 407 m. higher than the Lower Astin-tagh. A not inconsiderable rise can also be observed in the case of the Tschimen-tagh, which reaches 269 m. higher than the Akato-tagh. Between the two runs the important boundary of the Tschimen valley, that is between the three northernmost ranges on the one hand and the three ranges of Tschimen-tagh, Ara-tagh, and Kalta-alaghan on the other. The next valley boundary, that is from the orographical point of view, is the latitudinal valley of the Kum-köl, which separates the three ranges last-named on the one side from the Arka-tagh system on the other. The three ranges of the Tschimen-tagh, Ara-tagh, and Kalta-alaghan may thus be said to form an independent system, a transitional region from the most northerly border-ranges to the high Tibetan Arka-tagh.

In the three transitional ranges the differences of altitude are not great: the Ara-tagh is only 133 m. higher than the Tschimen-tagh, and this range lies only 89 m. lower than the Kalta-alaghan. But the difference between the three transitional ranges on the one side and Arka-tagh I on the other is by contrast all the greater. The rise from the Kalta-alaghan to Arka-tagh I is not less than 559 m., and it is only when we have climbed these 559 m. that we actually stand upon the true highland region of Tibet. If, finally, we compare the four Arka-tagh ranges one with another, we see that they are pretty nearly all of the same altitude, although there is a perceptible rise towards the south, so that the mean pass-altitude


PARALLEL RANGES
OF
EASTERN TIBET
Scale 1:3000000.
10 20 30 40 50 100 Km.
86°
87°
88°
89°
90°
91°
92°
39
38
37
36
35
34
Lower Astin tagh 3028
Upper Astin tagh 3435
Akato-tagh 3971
Chas kol
Tschimen tagh
4240
Kalta-Alaghan
Ajah kum-kol
4462
Ara-tagh
4375
Arka-tagh I
5021
Arka-tagh II
5193
Arka-tagh III
5210
Arka-tagh IV
5262
Koko-schili I
5138
Koko-schili II
5102
Dungbure I
4973
Dungbure II
5137
Dungbure III
5228
Buka-Magnä
5239
Tang-La I
Tang-L..
5411

of Arka-tagh IV is the loftiest of all. The principal thing however is that between 86° and 92° E. long. the ranges steadily increase in elevation from north to south, no one of them being higher than its neighbour on the south. The same conclusion is also shown very distinctly by the plate which I herewith append, giving profiles of all the meridional routes that I have mentioned.

We find the same uniformity again in both the absolute and relative mean altitudes in the latitudinal valleys. In their series the only exception is the Kum-köl valley. In them the rises from north to south are as follows: —

171 m.
267 »
681 »
176 »
— 207 »
883
198 »
69 »

Thus the highest or most southerly of these latitudinal valleys lies 2238 m. higher than the lowest, namely the latitudinal valley between the Lower Astin-tagh and the Upper Astin-tagh. It is a striking fact that this difference of elevation in the valleys is almost precisely the same as the difference of elevation between the mean pass-altitudes of the highest and the lowest of the parallel ranges, which we ascertained to be 2234 m. In the three northernmost latitudinal valleys there is a moderate rise in elevation, namely 171 m. from the first to the second and 267 m. from the second to the third. Now this third valley is the Tschimen valley, the importance of which as an orographical boundary is also evident from the fact, that the difference in altitude between that valley and the valley nearest to it on the south, belonging to the system of transitional ranges, amounts to no less than 681 m. After that the rise is of less magnitude, amounting only to 176 m., but then the two latitudinal valleys which lie only that distance one above the other belong to identically the same orographical system.

In the next step that we take towards the south we encounter however an exception to the general law laid down, for the Kum-köl valley lies 207 m. lower than its nearest neighbour on the north. But the climb up out of the Kum-köl valley to the first latitudinal valley in the Arka-tagh system is all the stiffer, amounting to no less than 883 m. Yet this does but serve to emphasise the importance of the Kum-köl depression as a boundary between the transitional region and the region of the Tibetan highlands. After that the rise is again slighter. Just as we found the four Arka-tagh ranges running at pretty much the same elevation, so the differences of altitude between the three intermediate latitudinal valleys are not particularly great.

The following table shows the depth of the nine successive latitudinal valleys in relation to the ranges that overlook them on each side. The first column shows the depth of the valley below the range on the north and the second column the depth below the range on the south.

First latitudinal valley	229 m.	636 m.
Second » »	465 »	1001 »
Tschimen valley	734 »	1003 »
Fourth latitudinal valley	322 »	455 »
Fifth » »	279 »	368 »
Kum-köl valley	575 »	1134 »
Seventh latitudinal valley	251 »	423 »
Eight » »	225 »	242 »
Ninth » »	173 »	225 »

From this table we see, to begin with, that it is just the two latitudinal valleys which we consider to be important orographical boundaries that are the deepest sunk, namely the Tschimen valley, 734 m. lower than the range on the north and 1003 m. lower than the range on the south, and the Kum-köl valley, 575 m. below the northern range and 1134 m. below the southern. The big Kakir valley, in which Usun-schor is situated, is likewise deeply sunk, namely to 465 and 1001 m. respectively. However no other general rule can be drawn from these figures except this, that the northern valleys are as a rule more deeply trenched than those to the south, a fact which follows of necessity from the position of the former in a peripheral region, or at all events from their situation next the edge of the Tibetan highlands, where erosion is more actively operative. What the relations are in this respect up on the plateau with its internal drainage we shall see presently.

CHAPTER XXXVIII.

OROGRAPHY OF THE TIBETAN HIGHLANDS.

Leaving behind us Northern Tibet with the Arka-tagh and its system of border-ranges, let us turn our attention to the highlands of Tibet, where, by way of a beginning, we will first study the two principal features of a physico-geographical character that are best known and most distinctly developed, namely the two pregnant trenches in the surface relief which are traversed on the map by my route and Wellby's, both of the year 1896. The mean absolute altitudes which we possess for these two latitudinal valleys are incomparably more trustworthy than all the means for the latitudinal valleys that we have already discussed, owing to the fewness of the data upon which these last are based. I have already quoted in a previous paper* one or two mean values for this region; but in these I am now constrained to make a slight alteration, not only because the new calculations are more accurate, but also because some of the altitudes taken in 1896 have now been properly corrected.

In my latitudinal valley the mean value of thirty-five fixed points, situated neither on the threshold passes nor yet in the depressions, amounts to 4892 m. The list of these measurements gives varying altitudes for two-thirds of the length of the latitudinal valley, though the variations are not great, ranging only between 5098 and 4810 m.; but in the remaining third, towards the east end, a distinct downward slope is noticeable in that same direction, where the lowest point lies at 4616 m. And the same observations apply to the corresponding parts of Wellby's latitudinal valley, except that they are more accentuated owing to his having crossed the last cross-threshold that serves as a boundary between the region of internal drainage and the source-region of the Tschumar river. Hence with regard to the extreme east of my latitudinal valley, we may as a general rule say that its internal-drainage basins lie increasingly lower towards the east (although there are exceptions) and the differences of level are but slight

The lakes in my latitudinal valley that were measured for altitude lie, going from west to east, at elevations of 4906, 4937, 4946, 4896, 4932, 4920, 4810, and

* *Seen in Tibet*, in *Zeitschrift d. Gesellsch. f. Erdkunde zu Berlin*, 1903, pp. 344 ff.

4616 m. Consequently their mean altitude is 4870 m., and that is also of course the mean value for the lowest depressions of the latitudinal valley. The cross-thresholds in this same valley lie, from west to east, at altitudes of 4920, 5026, 4990, 4992, 5116, 5059, 5099, 5085, and 4863 m. Hence their mean altitude, and coincidently therewith the mean altitude of the highest levels of the bottom of the valley, are thus 5017 m. The difference between these two means is therefore only 147 m.; whereas the difference in the absolute altitude between the highest point (5116 m.) and the lowest (4616 m.) amounts to exactly 500 m. Any way this valley is remarkably flat, and the rise from each depression to the nearest cross-threshold is almost always so slight as to be hardly noticeable. The only things that betray the flat undulations of the surface are the nearness or remoteness of the horizon, the presence of the lake depressions, and the existence of water-courses.

The altitudes which Wellby took in the big latitudinal valley which runs south of mine appear to be reliable and may readily be used for purposes of comparison. It is however matter for regret that he has seldom or never determined the altitude of the cross-thresholds, probably because they are in most cases so flat that their positions escaped his notice. If we confine our attention to that part of Wellby's journey which really appears to follow the identically same latitudinal valley, that is to say the stretch from his Camp No. 22 (about 80° E. long.) to Camp No. 80, and take the mean of fifty-seven altitudes which he obtained, we get as the result 5066 m. The reason why this datum is so much higher than the corresponding part of my valley is that the western half of Wellby's valley lies considerably higher than its eastern half, so that it is to the latter that the comparison ought strictly to be confined. The altitudes of the lakes in that part of Wellby's route which runs exactly south of my latitudinal valley are 4803, 4932, 5087, 4928, 4829, 4904, 5090, and 4800 m. Hence their mean altitude is 4921 m., or not less than 51 m. more than the mean for the lakes in my valley. I am however unable to accept his *data* in this case, because they are not the measurements of the water surfaces in the more prominent depressions; but some of them are measurements of small sheets of water lying at considerable elevations above the bottom of the valley, and others are the altitudes of his camps, though these were formed, it is true, quite close to the larger lakes, but no doubt at ten or twenty meters, or more, above their surface. Consequently Wellby's measurements of altitude admit of comparison with mine only in the case of those parts which lie between the same longitudes, that is to say the whole of that part of the northern latitudinal valley which I travelled through and that part of Wellby's valley which lies due south of it. Further we have to take into account *all* the measurements that were made, whether they are those of passes, lakes, or points intervening between the two. The mean of all my fifty-one points is 4912 m., and of all Wellby's thirty-one points 4922 m. It must however be observed, that the comparison does not run exactly on all fours, because not only has Wellby fewer data than I have, but he has given no attention to the cross-thresholds. As this latter would of course have increased his mean somewhat, but as, on the other hand, the inclusion of the altitudes at the lake-levels would have decreased it, we may take the figure quoted as being not very far from

the real figure, and the final result is, that Wellby's latitudinal valley lies higher than mine, though by a few meters only.

The mountain-system which separates these two valleys is the westward continuation of the Mongolian Koko-schili; and here again we are on somewhat uncertain ground. It is true there are six routes, two of which coincide in their passage across these mountains, though it is difficult or impossible to weld together into continuous chains the crests crossed over by the different travellers. When journeying south in 1901, I crossed over three distinct passes in the Koko-schili, and in the course of my 1900 journey, which lay very close to the former on the east, I crossed over five, and in my most easterly route I crossed over two, the ranges they belong to being identical with Bonvalot's immediately west of my third route just mentioned. Bonvalot's »Chaîn de Crevaux» is plainly the northernmost of the Koko-schili ranges, namely the one that bounds my latitudinal valley on the south. This range is the one that is easiest to trace, for there is reason to believe that each of the routes which cross my big latitudinal valley and which proceed from its lowest part towards the south, have to converge upon the pass in this northernmost range of the Koko-schili. I will however leave out of account the first of the passes that I crossed over in the middle one of my three routes, because there is no pass to correspond to it in the westernmost of those routes. On my general map I have endeavoured to trace what I take to be two parallel Koko-schili ranges, and for the northern one we have, proceeding from west to east, the altitudes 5020, 5337, 5151, and 5042 m., giving a mean of 5138 m. For the southern range we have only three altitudes, namely 5242, 5095, and 4970 m., or a mean of 5102 m. In the case of both of these, we may say, that as a rule they grow lower towards the east. The numerous passes which exist in certain parts of the system point however to the presence of minor parallel ranges intercalated between the larger ones, unless indeed they are simply spurs of secondary importance. For this reason it is almost impossible to speak of the existence of anything at all approaching to a definite latitudinal valley between the two ranges that I fancy we may trace; and the figures 4884, 4904, 5172, 5074, and 5000 m. (this last an interpolated estimate) are no doubt the altitudes of depressions between the two ranges, but they need not on that account belong of necessity to identically the same valley. The datum 5172 m. may however quite well belong to a swelling, corresponding to a cross-threshold, from which the latitudinal valley slopes away towards both east and west, although in point of elevation it surpasses the mean pass-altitude in both the northern and the southern Koko-schili range. The mean altitude for the depressions mentioned is 5007 m.

However uncertain these mean values are, owing to the fewness of the data, they nevertheless serve to suggest one or two important reflections. In the first place, we see that the latitudinal valley between the two Koko-schili ranges is of quite a different rank from the latitudinal valleys which Wellby and I explored; for these are especially broad, sharply defined, and made up of a series of self-contained basins, each with a salt lake at the bottom of it. Thus they are real, independent mountain-systems which these great valleys separate one from the other. The valley however which lies midway between them, *i. e.* that which lies between the Koko-

schili ranges is manifestly neither a salient nor yet a continuous feature of the country, but is rather more broken and irregular, much smaller, and in all probability incloses only a few self-contained basins and a few lakes. On the contrary the configuration appears to be of such a character that a river, which has its source between the two ranges, generally cuts its way through one of them, the northern range in order to reach my latitudinal valley and terminate in one or other of its lakes, the southern range in order to empty itself into one of Wellby's lakes. This obviously presupposes as a condition that that latitudinal valley, being as it is more intimately connected with the two Koko-schili ranges, must of necessity lie a step higher than the two big, more independent and detached latitudinal valleys, and in point of fact its mean altitude does run up to 5007 m., as compared with 4912 m. in the northern valley and 4922 in the southern.

Fig. 367. A SIDE-GLEN ON THE TIBETAN PLATEAU-LAND.

We have just ascertained that Arka-tagh IV is the highest of the ten North Tibetan ranges and possesses a mean pass-altitude of 5262 m. As we proceed northwards from this vast ridge, the other parallel ranges grow step by step lower, and the same thing holds good if you travel south from the same range, for the Koko-schili ranges reach altitudes of 5138 m. and 5102 m. respectively. In so far therefore as this part of Tibet is concerned, Arka-tagh IV may be regarded as the backbone or culminating ridge of the Tibetan highlands.

In the table given on pp. 563—564. I have put together the differences of altitude between the crests and the latitudinal valleys, and the result is, that we find them

decreasing as a rule from north to south, so that the ninth latitudinal valley lies only 173 m. lower than the crest of Arka-tagh III and 225 m. lower than the crest of Arka-tagh IV. If now we pass beyond the Koko-schili system, we shall find that the differences of altitude are still less when we contrast the latitudinal valley between these two ranges with the two ranges themselves, for it lies only 131 m. lower than the northern range and 95 m. lower than the southern. On the other hand my latitudinal valley forms an exception, for it lies no less than 350 m. lower than Arka-tagh IV and 226 m. lower than Koko-schili I. In the table to which I have just referred, we see that the Tschimen valley and the Kum-köl valley are relatively very deeply sunk between their containing mountains; and the same thing

Fig. 368. EROSION TERRACE IN WESTERN TIBET.

is true, though to a far less extent, in my latitudinal valley of 1896, and to an even less extent still in Wellby's latitudinal valley. These four latitudinal valleys may therefore be pronounced as of the first rank, and constitute striking and relatively deep trenches between the various *mountain-systems* of northern Tibet, whereas the other latitudinal valleys merely separate the *individual* ranges one from another. It is very interesting to observe, that these four valleys, taking them from north to south, grow increasingly shallower in relation to their containing ranges; that is, the difference of altitude betwen the bottom of the valley and the nearest range grows increasingly smaller. The only exception is the Kum-köl valley, which lies 131 m. lower in relation to Arka-tagh I than the Tschimen valley does in relation to the Tschimen-tagh. And if we take the mean of all the altitudes which I obtained in the Kum-köl basin, then the law just enunciated holds good also of that valley. That an association of this relative character must indeed exist is rather what might be expected. The reason why the two southern valleys are so slightly trenched is explicable by the advanced stage of the denudation on the adjacent mountains.

These older ranges have been for the most part worn down by denudation, and all that remains are flat ridges rising the merest trifle above the level of the contiguous latitudinal valleys. Add to this, that the two big latitudinal valleys possess no effluent, either to the ocean, or to East Turkestan, or to Tsajdam, but on the contrary are themselves divided into a number of small self-contained drainage-basins; and in consequence of that the solid material which is washed down by the streams is carried into the bottoms of the valleys, where it becomes deposited in the deeper parts of the depressions, raising their level continuously. In the Tschimen valley on the other hand the material is carried away partly to East Turkestan, partly to Tsajdam. From the Kum-köl depression it is not carried away, it is true, but that hollow may not only have been originally relatively deeper, but it is also bigger, and a longer time will be required to fill up its basin to the same degree as the relatively much smaller basins farther south. The recently enunciated law, that the big latitudinal valleys grow shallower and shallower the farther you proceed south does not however hold good right across the highland region of Tibet; for we shall soon reach one or two valleys which are rather deeply trenched in relation to the ranges that border them on each side.

No sooner do we get on the south side of Wellby's route than we are confronted with great uncertainty with regard to the position and direction of the mountain-ranges. Upon studying his map, we do, it is true, get the impression, that the part of his route which we are now discussing is bordered on the south by a fairly compact and continuous range; but when we compare his route with other routes in the same region, it turns out that the orography is by no means so simple. In this locality, again, we can no more talk of a single range than we can in the case of the Arka-tagh or the Koko-schili; but we can talk, legitimately enough, of a separate mountain-system, which according to the combined routes can be nothing else except a westward continuation of the Dungbure. The Dungbure proper lies immediately south of Wellby's route, though its crest is there highly irregular. My route of the summer of 1900 intersects Wellby's in two places. His lake of 6th August, which he calls »Salt Lake», is unquestionably identical with my big salt lake; the reason that Wellby does not show the western, freshwater lake, which empties itself by a broad sound into the salt lake, is simply this, that his route ran to the north of it and he really did not see it. Wellby's salt lake of 28th July corresponds to my salt lake of Camp LV. When a map of Wellby's itinerary is placed upon my map on the scale of 1 : 1,000,000, the two lakes are seen practically to coincide in position, though not completely so, for Wellby's two lakes overlap a few minutes to the east. That portion of my route which describes an arc of a circle from the eastern lake to the western, south of Wellby's route, proves, that it would be altogether inappropriate to speak about a distinct mountain-range, for the Dungbure is there very flat and split up into a number of small parallel ranges. In the interval between my big salt lake and the two freshwater lakes, that is to say between Camp XXXIII and Camp XXXVI, I did not cross over anything that could be called a mountain-range, the highest point along that section of the journey being 4934 m. The surface was, it it true, markedly undulating, with detached ridges and lines of heights, but still on the whole relatively level.

Along the stretch between Camp XLIX and LV, where the westward continuation of the Dungbure ought to have been met with, the greatest altitude amounted to 5072 m., and there it would be still less appropriate to speak of a definitive range. In point of actual fact the greater part of that section of the journey ran through a latitudinal valley with a south-east and north-west direction, proving that the mountain-ranges in that region incline towards the south-east and east-south-east. Nevertheless I believe the orographical structure may be conceived in the way that I have reproduced it on my general map, namely as a double range, which I have called Dungbure I and Dungbure II, the more southerly of which probably corresponds to Bonvalot's »Chaîne des Volcans». Both are flat, uneven, and broken, the southern

Fig. 369. EROSION TERRACES IN WESTERN TIBET.

one in particular being diversified by the lakes which I discovered between Camp XXXVI and Camp XLI. But the range which I have called Dungbure III, although it ought possibly to be regarded rather as belonging to another mountain-system situated beyond and south of the Dungbure proper, can, on the other hand, be traced in the portion of Tibet which we are discussing, with a very fair degree of probability. This, then, is the range which was crossed over a long way to the west, as I believe, by Dutreuil de Rhins by the pass which he called »Passe du Chasseur» (5362 m.), further at a very short distance east of De Rhins's route by Littledale by a pass which he gives as being 4953 m. high, and by myself when going down towards Lhasa by a pass at an altitude of 5056 m., after which the range continues towards the east-south-east. I came into contact with it again at the pass with an altitude of 5426 m. Though this was no doubt a pass of secondary importance, it can nevertheless be used for calculating the mean pass-altitude. In this very same region Bonvalot gives two altitudes of 5188 and 5450 m., that is assuming there is no error of longitude. After that the same range continues due east;

we saw its crest distinctly south of the two freshwater lakes at Camp XLI. Thus as the mean pass-altitude of Dungbure III I obtain 5228 m., which proves that this crest is higher than the two Koko-schili ranges and only very slightly lower than the loftiest of the Arka-tagh ranges. The corresponding value for Dungbure I is 4973 m. and for Dungbure II 5137 m. The valley which lies between them has, according to existing observations, a mean altitude of 4856 m., whereas the valley between Dungbure II and Dungbure III has an altitude of 4924 m., or almost exactly the same as Wellby's latitudinal valley. The mean altitude of the valley south of Dungbure III is 4915 m. The figure which I give for the latitudinal valley between Dungbure II and Dungdure III may be regarded as trustworthy, seeing that it is calculated from thirteen observations, for the valley is traversed in part both by my own and by Wellby's itineraries. Although I have in the foregoing discussion assumed that Wellby's route ran through one continuous main valley only, in this particular part of it it does look, I confess, as though he really travelled in two separate latitudinal valleys. This is not however apparent from his map; but the direction of the mountain-ranges, from west-north-west to east-south-east, in this region suggests that his itinerary, which just there ran due east, must have crossed over the crest of what I have called Dungbure II, and precisely in the locality where that range ought theoretically to exist Wellby travelled for two short stages due north, not with the view of seeking the shortest and easiest way across a pass, but in order that he might follow the river which flows down to the salt lake of 28th July, so that it would undoubtedly appear to cut through Dungbure II in a transverse glen. This stream has its sources in Dungbure I, the principal chain in that region.

One more step towards the south and it is still possible to trace the probable west-north-west to east-south-east direction of the ranges. South of Dungbure III and separated from it by a latitudinal valley, with an altitude of 4915 m., runs a mountain-range; this is bordered on the north by that part of my route towards Tengri-nor which comes between Camp XXXIV and Camp XXXIX. Thanks to the pass-crossings, this same range can be detected on the itineraries of Dutreuil de Rhins, Littledale, my own, and Bonvalot's routes, and farther east it is probably connected with the Buka-magnä range, which is crossed by the usual road of the Mongol pilgrims by the Buka-magnä pass, at a spot where the range is considerably lower than in the part of Tibet with which we are more especially concerned. The passes known along this range lie, from west to east, at 5122, 5099, 5186, and 5750 m. The last of the four is situated on Bonvalot's route and is a highly improbable figure, the altitude being undoubtedly exaggerated. The mean value is however 5289 m.

South of the Buka-magnä comes the big latitudinal valley which I followed when I went down to my headquarters Camp XLIV; on the west it seems to be continuous with Dutreuil de Rhins's »Vallée des Lacs Jumeaux». These two lakes stretch from east to west and show that the valley makes a slight curve. The »Lac du Cratère», which lies immediately north of the same two lakes, may be regarded as belonging to this valley, although they are separated by a low crest. The mean of seven altitudes taken in the valley is 5022 m. Consequently this latitudinal valley lies at the same elevation as the crest of Arka-tagh I.

South of this valley come the three ranges which I take to be the westward continuations of the Tang-la system. With the help of the known passes we are able to trace them through our defined area, wherein they appear to form three parallel crests of the same altitude, though each of them varies very much in elevation in its different parts. I will call them here Tang-la I, II, and III. The northernmost of these, Tang-la I, corresponds to Bonvalot's »Monts Dupleix»; which name Grenard retains on his general orographical map, though he makes it curve southwards, and in that section places Littledale's pass of 5898 m., reducing its altitude however to 5600 m. To the westward continuation of the same range he gives the name of »Mts Dutreuil de Rhins», and links it on to the Aru-gangri and the ranges that run north of the Panggong-tso and the Indus. To the same prolonged range Grenard likewise assigns the Kara-korum and the Kara-korum pass; and in this I fully agree with him, although certain particulars in the course given to these ranges on his map are doubtful. He has however done his best to interpolate in those regions in which our knowledge is defective. On the whole however he is undoubtedly right, and when I crossed over the lofty pass at 5462 m. altitude it struck me at once that the stupendous range in which that pass is situated really is a link between the Tang-la and the Kara-korum. Possibly too the detailed explorations of the future will prove that this great range or system of ranges, which stretches all the way across the Tibetan highlands, is to be regarded as the most imposing system of mountains not of Asia only, but of the whole earth, not even excepting the Arka-tagh. It is probable that, while the Arka-tagh may be said to be the backbone of the Kwen-lun system, this more southerly range forms the culminating ridge of the Tibetan high plateau.

With a little trouble you can however detect on Grenard's map three more or less parallel Tang-la ranges: — (1) Mts Dutreuil de Rhins — Monts Dupleix; (2) Mts Henri d'Orléans — Mts Littledale; (3) Monts Bonvalot. He however interweaves these ranges together in such a way that the Tang-la proper splits up into (1) and (2), while (3) divides into (2) and a more southerly range, to which he gives no name. This may possibly be the correct interpretation, although I have preferred to distinguish three parallel main ranges.

Tang-la I, corresponding to Monts Dupleix, possesses three known passes — in the west that of Dutreuil de Rhins at 5480 m ; then Littledale's at 5141 m., situated quite close to a peak measuring 5757 m.; and Bonvalot's pass of 6000 m., which may pretty safely be set down as 600 m. too high. In order to reduce this last elevation to a more modest level, I will make use of Rockhill's altitude of 5024 m. of the 26th June, which lies directly along the prolongation of the range. This brings the mean pass-altitude down to 5411 m. I myself crossed over this range in a transverse glen, breached by the river that rises on a pass, at an altitude of 5462 m., in Tang-la II, which range I consider to be identical with the true main range of the Tang-la.

In this range, Tang-la II, we have the following four altitudes: — that of Dutreuil de Rhins at 5630 m., of Littledale at 5239 m., my own at 5462 m., and that of Bonvalot at 5480 m., giving a mean value of 5453 m. Between these two ranges runs a latitudinal valley, of which we again possess four altitudes, namely

5280, 4873, 5288, and 4924 m., this last occurring on Rockhill's itinerary; the mean value is 5091 m. Consequently this valley is trenched to the depth of some 350 m. lower than its two containing ranges.

In Tang-la III we likewise have four passes, namely that of De Rhins, 5163 m.; Littledale's pass, which is marked 5899 m. on his map, though Grenard, as I have said, reduces the figure to 5600 m. (and this is nearer the probable true value, although *Stieler's Hand-atlas* accepts the exaggerated altitude); then my pass at 5367 m.; and lastly Bonvalot's at 5500 m. (the beautiful round numbers which he generally gives are in themselves suspicious). However the values just quoted yield a mean pass-altitude of 5408 m. for Tang-la III.

For the latitudinal valley between Tang-la II and Tang-la III we have the following altitudes — 4923, 5228, 5237, 5260, and 4819 m., or a mean altitude of 5093 m., almost exactly the same value as for the immediately preceding latitudinal valley. For the latitudinal valley south of Tang-la III we have these altitudes — 4698, 5356, 5127, 5063, 5070, 5028, and 5200 m., giving a mean of 5077 m., which again differs but little from the last two latitudinal valleys belonging to the Tang-la system.

All the way from the three Tang-la ranges to the southern boundary of the region which we are considering, that is to say to 31° N. lat., the uncertainty which prevails with regard to the course of the ranges is greater than hitherto, notwithstanding that the travellers' routes run closer together. For we have now to take into consideration both Bower's loop towards the north and Rockhill's loop towards the west, besides which my own route, all the way from Camp XLIV, is divided into two branches, of which that to the east is in places double. Unfortunately just along this very stretch Rockhill gives no pass; possibly he did not cross over any of any altitude worth speaking about, just as I myself in the course of my dash towards the south crossed over none but very low and relatively unimportant passes. In this region the altitudes which I measured all range round about 4850 m. Bonvalot however gets in the same region a pass at 5850 m.; but that is quite in keeping with the general run of his altitudes. Littledale's pass of 5640 m. and Bower's of 5722 m. in this same region are also doubtful. On the other hand Dutreuil de Rhins, still in this same region, traversed a remarkably low district, with altitudes going down to 4450 m. and with a maximum pass-altitude of 5134 m.

From my two itineraries in this part of the country I obtained the distinct impression that the orographical architecture of this region is far less regular than that of any portion of Tibet to the north of it. It is very seldom that you can speak of definitive mountain-ranges running parallel to one another, and equally seldom of lengthy latitudinal valleys. Both ranges and valleys are of smaller size than hitherto, and often the traveller finds himself wandering in a labyrinth of low hills, amid which the eye is unable to trace out any distinct main range. In a word, the conformation is less regular and the ranges frequently run in directions that deviate from the usual east and west. Between the Tang-la system on the north and the vast mountain-system that accompanied us all the way to Ladak on the south, the orographical structure of the Tibetan highlands is in one word less regular than that of the country which borders that zone on north and south, though that zone itself

is only known in part. As for the eastern portion of that zone, and it is with it alone that we are now concerned, the very fact of this irregularity of altitude along routes which run so close together proves that the surface features are very uneven. In some places the country is very flat, in other places it rises into particularly lofty swellings, and in yet others it is strangely broken by irregular stretches of hills. The latitudinal valley which occurs in the southern portion of the area expands into one of the largest internal-drainage basins in Tibet, forming a homologue to the Kum-köl basin in the north. In the same zone we find also the biggest river of the internal-drainage region of Tibet, namely the Satschu-tsangpo. Were the surface conformation here the same that it is in the north, this river would be broken up into several smaller streams, belonging to various latitudinal valleys, each possessing its own terminal lake. But the great flatness of the country and the absence of water-dividing ranges are circumstances which directly facilitate the gathering of the waters into a big river. And it is owing to precisely the same causes that such a large and extensive lake as the Selling-tso has been able to come into existence. The western continuation of this latitudinal valley narrows considerably, and in consequence the lakes which lie in that direction, namely the Tschargut-tso, Addan-tso, and Dagtse-tso, are of far smaller area, the first-named being also very narrow. Nevertheless it is quite evident to the eye that in this particular latitudinal valley the ranges do run very consistently east and west, *e. g.* on the shores of the Tschargut-tso and on the large island of the Naktsong-tso. But opportunities for guesses and speculations are exceptionally plentiful in this region, and it is very difficult to determine in which direction and in what manner these ranges merge into the world of big mountain-ranges amongst which the head-feeders of the Indo-Chinese rivers are situated. Bower's, Bonvalot's, Rockhill's, and my own routes, which are here interlaced together, are not sufficient to justify us in drawing safe conclusions. I believe however, that the ranges which our routes cross over, after having described a curve towards the north, incline towards the east-south-east and south-east. If that is so, the Satschu-tsangpo would break through several of them in its upper course; but for the greater part of its lower course it will flow south of the most southerly of them, and parallel to it.

On the provisional general map which I have drawn I have, with the help of itineraries, attempted to enter all the mountain-ranges that exist in this region, although in so doing I was haunted by a feeling of great uncertainty. Possibly after the more deliberate map on the scale of 1 : 1,000,000, which is to be included in my atlas, shall have been completed, it may then be easier to draw sound conclusions. My present attempt is, as I have already said, entirely tentative.

For practical reasons I call this region, which extends from the Tang-la ranges southwards to the latitudinal valley with the lakes, Tschang, the name which the Tibetans themselves give to the high, uninhabited plateau; and here I will endeavour to distinguish seven ranges. The one farthest north, Tschang I, seems to be the easiest to follow, that is assuming that the following altitudes belong to this range — 4713 (De Rhins), 5473 (Littledale), 5236 and 5211 (my two routes), and 5350 (Bonvalot). Thus the mean pass-altitude for Tschang I is 5197 m. The mean altitude of the latitudinal valley south of this range is 4821 m. In Tschang II we have

the following altitudes — 4675 m. (De Rhins), 5479 (Littledale), 5246 (Hedin), and 5300 (Bonvalot), the mean being 5175 m. For the next latitudinal valley to the south the mean of five measurements is 4913 m. The range which I call Tschang III appears to be broken or to taper away towards the east, and nobody has crossed it except Littledale, by a pass at 5640 m., an altogether improbable figure. For the next latitudinal valley we have three altitudes, giving a mean of 4850 m. For Tschang IV we have 4785 (De Rhins), 5110 and 5396 (Bower), 5089 (Hedin), 5550 (Bonvalot), and 5113 m. (Hedin); thus the mean pass-altitude of this range is 5174 m. For the latitudinal valley south of it we have a great number of altitudes, principally due to the fact that a very considerable portion of Bower's route ran through it. Upon studying Bower's map, we get very clearly the impression that, with the view of avoiding tiring passes, he tried to keep as far as possible to the bottom of the valley intermediate between the two neighbouring ranges. His map shows therefore for this locality only one or two insignificant passes, which doubtless are to be regarded as cross-thresholds of the valley. Most of the twenty-four altitudes which we have for this valley are, then, Bower's, and their mean works out at 4873 m., a result that may be accepted as fairly trustworthy. Hence this valley lies 300 m. lower than Tschang IV.

In the range Tschang V we have the altitudes 5134 (De Rhins), 4988 (Bower), 5090 (Littledale), 5083 (Hedin), 5250 (Bonvalot), and 4945 m. (Hedin), giving a mean of 5081 m. The latitudinal valley to the south lies 280 m. lower, or at a mean altitude of 4801 m. The following pass-altitudes belong to Tschang VI — 5085 (Bower), 5722 (Bower), 5100 (Littledale), 4909 (Hedin), and 4837 m. (Hedin), the mean being 5131 m. For the latitudinal valley which lies next on the south the mean altitude is 4702 m., or more than 400 m. below the crest of the range.

Tschang VII is difficult to follow. In the localities where I show one range there are in reality several ranges, all of them small and very often broken; all the way from Camp LXV to Camp LXXII, for instance, I hardly crossed over a single pass; everywhere we were able to advance between the short, rounded ranges. It is along this stretch of country however that we have Bonvalot's pass of 5850 m., though, judging from the observations of other travellers in the same region, this figure is exaggerated to the extent of upwards of 1000 m. But putting this *datum* on one side, we have, without it, 5222 (Bower), 4949 (Littledale), and 4859 m. (Hedin), which gives a mean of 5010 m. This same system was crossed farther west by Bower and Dutreuil de Rhins, but both seem to have used gaps between the separate ranges. The altitudinal relations of the valley south of Tschang VII are fairly well known, and of twenty-three measurements the mean altitude is 4651 m.

Of the vast and imposing range which runs south of the valley last referred to I know nothing beyong the fact, that I had it on my left hand the whole of the way to the Panggong-tso. Probably it consists of a series of parallel ranges with a main range, which swells up here and there into higher elevations capped with perpetual snow and ice. Dutreuil de Rhins crossed north of the Tengri-nor over a pass called Redjen-la, with an altitude of 5094 m. Immediately west of that Littledale gives a swelling of 5005 m., and east of the same Bonvalot records an altidetu of 5450 m. Practically nothing is known of the westward continuation of that

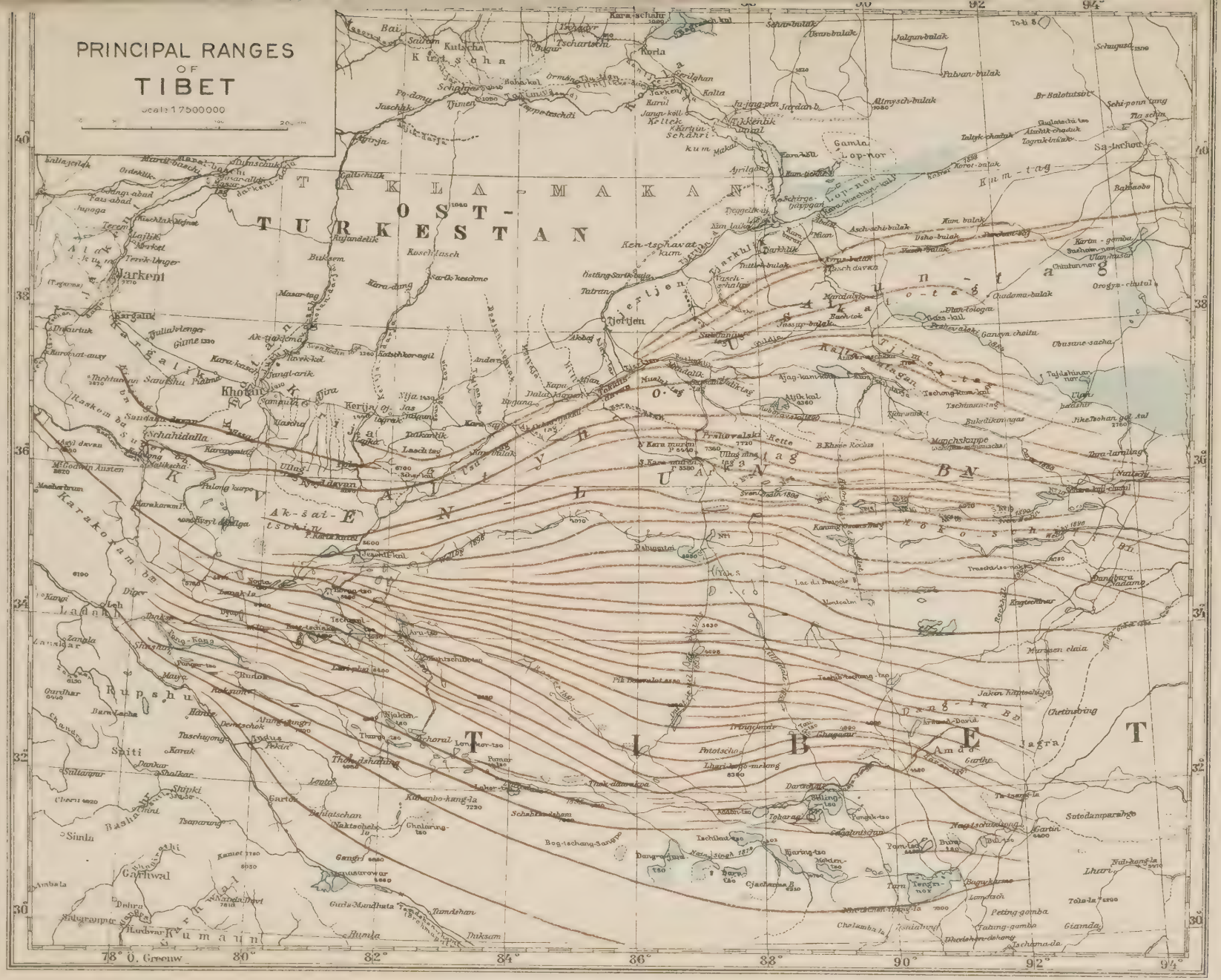
range, except that Nain Singh crossed over it by the pass of Kilong, situated immediately north-west of the northern point of the Dangra-jum-tso, and to that pass he assigns an altitude of 5540 m.; probably this is not exaggerated, when it is remembered that the range to which it belongs is one of the first magnitude. On Grenard's map this range is also indicated with heavy hatchments. The Scha-gandschum, Tok-dschalung, and Alung-gangri may no doubt be considered as parts of this range. South of it stretches a perfect *terra incognita*. Just as this last-mentioned range forms the northern boundary of Nain Singh's lacustrine basin and serves as a water-parting between it and the Selling-tso lakes, so we may take it that the Dangra-jum-tso and the groups of lakes to which it belongs are bounded on the south by an important main range running parallel with that on the north. And another big range overlooks, I believe, the northern bank of the Tsangpo. Between these two systems, of which there is not a sign on our maps, I assume that there exists a particularly broad and extensive latitudinal valley, which, I dare say, includes a vast number of lakes, amongst them being the Karmo-tso, Ruldap-tso, Galaring-tso, and Mun-tso, which have been located on the maps from hearsay. Between the last-named and the Dangra-jum-tso Nain Singh has drawn a big range, which he entitles the »Targot Lha, Snowy Peaks». This is undoubtedly a westward continuation of the great range of Nintschen-tang-la, which rises south of the Tengri-nor. To the southernmost range, namely that which overlooks the left bank of the Tsangpo, we may count the Kailas mountains north of the Manasarovar lakes. The most definite and the largest of all the Tibetan latitudinal valleys is that which contains the upper Indus, the Manasarovar lakes, and the upper Brahmaputra; in fact, it would be impossible to define the course of a valley better than is done in this case by these two rivers.

I have already given a table of the ranges in northern Tibet down as far as Arka-tagh IV. For the sake of completeness I will here bring together in one list all the ranges and intervening valleys which we have been discussing from the outset:

Lower Astin-tagh	3028 m.
Latitudinal valley	2799 m.
Upper Astin-tagh	3435 m.
Latitudinal valley	2970 »
Akato-tagh	3971 m.
Tschimen valley	3237 »
Tschimen-tagh	4240 m.
Latitudinal valley	3918 »
Ara-tagh	4373 m.
Latitudinal valley	4094 »
Kalta-alaghan	4462 m.
Kum-köl valley	3887 »
Arka-tagh I	5021 m.
Latitudinal valley	4770 »
Arka-tagh II	5193 m.
Latitudinal valley	4968 »

Arka-tagh III	5210 m.
Latitudinal valley	5037 m.
Arka-tagh IV	5262 m.
My latitudinal valley of 1896	4912 »
Koko-schili I	5138 m.
Latitudinal valley	5007 »
Koko-schili II	5102 m.
Wellby's latitudinal valley	4922 »
Dungbure I	4973 m.
Latitudinal valley	4856 »
Dungbure II	5137 m.
Latitudinal valley	4922 »
Dungbure III	5228 m.
Latitudinal valley	4915 »
Buka-magnä	5289 m.
Latitudinal valley	5022 »
Tang-la I	5411 m.
Latitudinal valley	5091 »
Tang-la II	5453 m.
Latitudinal valley	5093 »
Tang-la III	5408 m.
Latitudinal valley	5077 »
Tschang I	5197 m.
Latitudinal valley	4821 »
Tschang II	5175 m.
Latitudinal valley	4913 »
Tschang III	? m.
Latitudinal valley	4850 »
Tschang IV	5174 m.
Latitudinal valley	4873 »
Tschang V	5081 m.
Latitudinal valley	4801 »
Tschang VI	5131 m.
Latitudinal valley	4702 »
Tschang VII	5010 m.
Latitudinal valley	4651 »

In this list there are consequently included twenty-six parallel mountain-ranges crossing the Tibetan highlands from east to west between 86° and 92° E. long. To these we may unquestionably add four more in the south before we reach the regions that belong to the peripheral parts of the country and that drain down into the ocean. The immense Tibetan upswelling has thus in this section been crumpled into some thirty folds, to say nothing of all the quite short minor parallel ranges that lie intercalated between the big ones. Ranges of this character are particularly numerous in the latitudinal valley which contains the Selling-tso lakes, and they were equally


PRINCIPAL RANGES
OF
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Kuen-lun
Altyn-tag
Arka-tag
Kara-tag
Kara-kasch
Yurung-kasch
Tschang-tschenmo
Kara-korum
Ak-sai-tschin
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Sanju-la
Kara-tschahur
Kutscha
Karla
Karkent
Yarkand
Khotan
Kiria
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Tschertschen-tagh

numerous all the way to the Panggong-tso. From higher points of vantage you can often count whole series of them, especially towards the north. From the above table it is however clear, that the three ranges which I consider to belong to the Tang-la system are the loftiest, and that absolutely the loftiest of all is the middle one, Tang-la II, which reaches a mean altitude of 5453 m. From this sublime elevation the ranges decrease in altitude both southwards and northwards, the only exception being the Arka-tagh, in which the altitude again increases. But the highest Arka-tagh range is nearly 200 m. lower than the highest Tang-la range. And precisely the same observations hold good of the latitudinal valleys: the three that lie nearest to the Tang-la ranges are the highest, the absolutely highest being the middle one at an elevation of 5093 m.

CHAPTER XXXIX.

HYPSOMETRY AND RELIEF OF THE TIBETAN PLATEAU.

By the Tibetan highlands with internal drainage, or the central plateau, I understand the whole of that part of Tibet which is bounded on the north by the water-divides of all the rivers that flow down to East Turkestan, on the east by the water-divides first of the rivers that flow into Tsajdam and secondly of the great Indo-Chinese rivers, on the south by the water-divides of the rivers which flow into the Tsangpo and upper Indus, and on the west by the water-divides of the rivers that empty themselves partly into the upper Indus, partly into the Jarkent-darja and Chotan-darja. The only district about which uncertainty can exist, as to whether it belongs to this highland region or not, is the basin of the Kum-köl. By reason of its peculiar situation and its relatively unimportant absolute altitude that basin may be considered to form a transitional zone between the central and the peripheral regions.

At all events this central internal-drainage country resembles in shape an isosceles triangle, having its base or greatest breadth in the east, from which it tapers away towards its apex in the west. We have found however that this region cannot be regarded — as hitherto has been the practice — as a plateau country in the ordinary acceptation of the term, but it is traversed by a great number of mountain-ranges, which in general diverge somewhat towards the east. When we come to consider the mean altitude of this region, our first procedure is to divide it, in accordance with its general surface configuration, into several different altitudinal zones. And first of all we have to deal with the true, dominating plateau, or fairly level base or socle upon which the mountain-ranges have been reared up; and its mean altitude is dictated by the mean altitude of the latitudinal valleys. Then we have to deal with the mean altitude of the depressions, and that is obtained from the mean of all the lakes; the absolute mean altitude for the depressions is obtained from the mean for the salt lakes, which occupy the very lowest absolute levels in all parts of the country. Finally, we have to consider the mean altitude of the cross-thresholds in the latitudinal valleys, as well as the mean altitude of the passes which cross the east-west mountain-ranges. For the next highest altitudinal level above that there exists no possibility of deducing a mean value, owing to

lack of material. For instance, it is not possible to form any idea of the mean crest-altitude, although we may conjecture, that this does not in general exceed the mean pass-altitude by more meters than the mean pass-altitude exceeds the mean altitude of the nearest latitudinal valley, or by about 300 m. Equally impossible is it to determine the mean altitude of the insular, glacier-crowned summits, that is to say the mean altitude of the culminating points of the highlands. Other levels the mean values of which it must be left to the future to determine are the height to which the glacier-arms descend, the mean value of the absolute limits of vegetation, the mean altitude of the snow-line, and so forth.

Fig. 370. DEAP-CUT VALLEY IN NORTHERN TIBET.

For the time being there exists with regard to all these ample room for speculation and guess-work, and consequently it would at the present moment be anything but a grateful task to attempt to construct a hypsometrical map of the whole of Tibet. The white patches in the interior, and throughout the whole of the region north of the upper Tsangpo, are still far too big. Indeed, I will go so far as to declare, that, considering the knowledge which we at present possess regarding the altitudes, the hypsometrical map of the region between 86° and 92°, which has been traversed by several travellers, does not possess any special value. If the determinations of altitude along the meridional routes be used in the way in which I have attempted to use them in the last chapter or two, as a basis for calculating the mean altitude of identically the same range, then the mean altitude of that range may very readily be compared with the mean altitude of another range that is crossed by the same route; for the same errors are repeated in the same proportion in both ranges, and the result is therefore relatively permissible and reliable. But the case is quite different if we attempt to work out the mean altitude along a meridional line, because for that we have to use the route of one and the same traveller. If, for

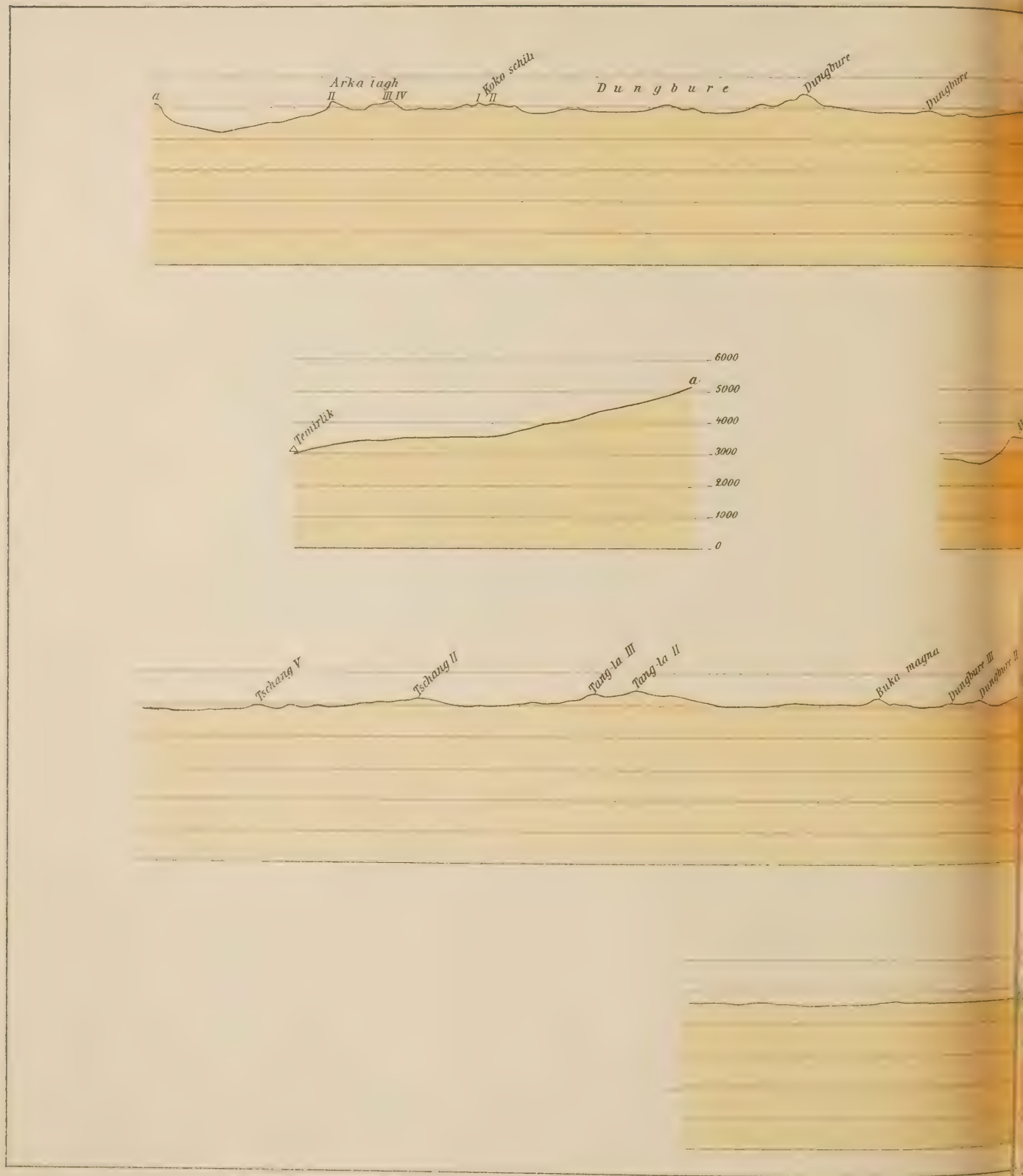
instance, on the basis of all the routes that fall between 86° and 92° we seek to estimate the extent of the eastward or westward slope of the internal-drainage area of Tibet, or do ascertain whether it maintains on the whole a uniform level, we find it perfectly impossible to arrive at any trustworthy result by comparing the different routes together. For instance, I am not for one moment tempted to compare Bonvalot's altitudes with my own; for to do so would lead to the perfectly absurd result, that, because his altitudes are all considerably higher than mine, the country from the meridian at which he travelled consequently sinks down, on both east and west, to my neighbouring routes.

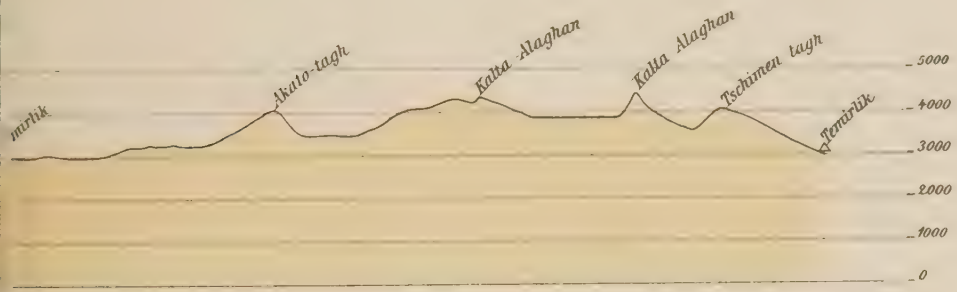
Fig. 371. ON THE BANK OF THE TSANGER-SCHAR.

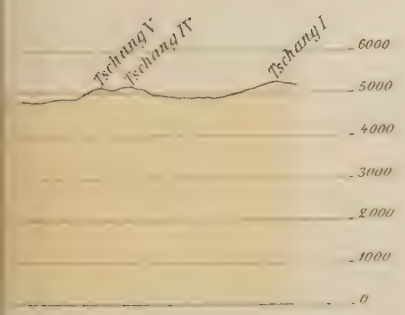
Nevertheless even from the defective knowledge of Tibet which we do possess we can deduce certain general conclusions. I am of opinion, that the zone which stretches between the culminating crest of the Arka-tagh and the culminating crest of the Tang-la is to be regarded as the highest part of the base of the Tibetan plateau. From both those boundary walls the country falls away to north and to south. How far that zone extends towards the west it is impossible to say; but we may in the meantime assume that it reaches just as far as the two culminating crests themselves do. It can also be established *à priori*, that the southern half of Tibet is lower than the northern. The central portion of the country appears to be tolerably uniform in height, but at its eastern margin a decided eastward droop can be detected, and it is distinctly perceptible in my latitudinal valley and in Wellby's, and in the directions in which the Indo-Chinese rivers flow. If we study the immense latitudinal valley which embraces the upper courses of the Indus and the Tsangpo, we find that its water-divide is situated a long way towards the west, and that the whole course of the Tsangpo betrays a decided fall towards the east.

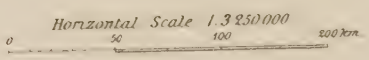
Leaving out of account the blank central parts of Tibet, it is always possible to institute a comparison between the mean altitudes in the region which we have

Dr. Sven Hedin: Journey in Central Asia 1899-1902.









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discussed above and the mean altitudes in the known parts of western Tibet which are restricted to internal drainage. In the former we have a mean pass-altitude of 5189 m., counting from Arka-tagh I to Tschang VII. For the twenty intervening latitudinal valleys we obtain a mean altitude of 4910 m., and this we may take as the altitude of the fundamental base or socle of this part of Tibet. Generally speaking therefore, this base lies 100 m. higher than the summit of Mont Blanc. Hence the difference in altitude between it and the mean pass-altitude amounts to only 279 m. From this it is evident, that the *relative* altitude of the mountain-ranges on the Tibetan plateau is very unimportant, and it is easy to understand why some travellers designate these crests as »hills», notwithstanding that they reach altitudes of 5,500 m. above the level of the sea. If we suppose that the real crest-altitude rises as far above the pass-altitude as this last rises above the base-altitude of the plateau, the mean altitude of the crests would be about 5470 m., or in round numbers 5500 m. Individual parts of these crests reach up to 6000 m., and an occasional peak to 7000 m., although of these there exists no great number. I very much doubt whether any peak in this part of Tibet attains an elevation of 8000 m., though Bonvalot gives this as the altitude of the Dupleix range; for it is probable that within this peculiar denudation region there exists a superior denudation limit above which no single summit has been able to lift itself within the present geological epoch.

Let us now endeavour to ascertain what are the hypsometrical relations between eastern and western Tibet; and first we will examine the results arrived at by the five most distinguished travellers who have explored the internal-drainage area of western Tibet. When we come to calculate the mean pass-altitude we are however often in doubt. With the English travellers the word »pass» can in most cases indicate nothing more than cross-thresholds in the latitudinal valleys, the altitudes of which are extremely small, often less than the altitude of an adjacent camp. Consequently their maps yield only very few passes of the first magnitude. It is only in Dutreuil de Rhins that passes of that category are fairly numerous (14) and distinctly marked as such. But the figures which we get for the mean altitude of the socle or base are all the more reliable, for each of these travellers naturally preferred to encamp in the bottom of the valleys as frequently as possible. The result of my inquiry is as follows.

From Bower's map I have extracted four passes giving a mean altitude of 5502 m. and twelve altitudes for the base, giving a mean of 5312 m. From De Rhins's map I get fourteen passes, giving 5448 m., and thirty-five base measurements, giving 5139 m. Wellby supplies two passes, with 5587 m.; and twenty-nine base measurements, which give 5139 m. From Deasy I obtain two passes, with 5412 m. and fifty-seven base altitudes, resulting in a mean of 5005 m. Rawling furnishes two passes and twenty base *data*, with means of 5587 and 5183 m. respectively. The result is set forth more clearly in the subjoined table: —

	Bower.	De Rhins.	Wellby.	Deasy.	Rawling.
Pass-altitude	5502	5448	5587	5412	5587
Base-altitude	5312	5139	5139	5005	5183
Difference	190	309	448	407	404

A fairly close agreement is therefore to be noted in the altitudinal observations of these different travellers. In the case of the passes Wellby and Rawling agree exactly, and in the case of the base De Rhins and Wellby are likewise in exact agreement. The great difference of 300 m. for the base altitude which exists between Bower and Deasy admits of very easy explanation. Bower's route clearly ran through the very highest part of the western plateau country of Tibet, whereas Deasy travelled farther south in relatively low country. However, the total observations of the five journeys yield an exceptionally sound mean value for the whole of the region in question. The mean pass-altitude, thus obtained, is 5477 m. and the mean base-altitude 5109 m., so that the difference between the pass-altitude and the base-altitude is thus 368 m. The final result of the whole inquiry is therefore as follows: —

	Western Tibet.	Eastern Tibet.	Difference.
Pass-altitude	5477	5189	288
Base-altitude	5109	4910	199
Difference	368	279	89

The figures are particularly interesting. They tell us that the passes in western Tibet are on the average 288 m. higher than the passes in eastern Tibet, and that the fundamental base is nearly 200 m. higher in the west than in the east. This agrees with the *à priori* assumption, that the great Tibetan upswelling slopes as a whole downwards towards the east, as indeed some of the rivers generally indicate. It is also congruent with the premisses which we have already laid down, that the great Tibetan upswelling, in virtue of the more forcible pressure exercised upon it in the west, must be higher in that quarter than in the east, where the folding was less energetic. On the other hand the following circumstance is striking, though it may be set down as accidental. The distance between the approximate centre of the western region which we have just been considering and the approximate centre of the more easterly region with which I dealt in the last two chapters amounts to about 700 km. The distance between the confluence of the Jarkent-darja and the Kaschgar-darja and the point where the Tarim turns towards the south also amounts to 700 km., and along this stretch the contour falls 200 m., or precisely the same extent as in the corresponding distance in Tibet. But this is, as I say, probably a mere coincidence.

I have already called attention to the fact that a large area of the interior of Tibet is practically quite unknown. A single glance at the map is sufficient to show, that the meridional belt between 83° and 87° E. long. is entirely white, with the exception of four narrow latitudinal strips. *One* conclusion can however be drawn from the existing material, and that is that throughout the whole of that area the surface slopes not only from west to east — this is patent from the explorers' routes and from the fall of the Tsangpo — but also from north to south — as is plain from the means of the altitudes measured along the different routes. With the view of choosing the zone in which these four routes shall lie as far apart as possible, let us confine our attention to the region between 82° and 86°. This zone, through which my route runs, was traversed also by Nain Singh and Littledale; and although

my itinerary did not coincide with theirs, nevertheless I look upon this zone as simply one, even though it may be spoken of as three. In point of actual fact however the meridional strip as defined above has been traversed by six routes, namely from north to south by Wellby, Bower, Nain Singh, Littledale, myself, and Nain Singh again, and to these must be added a seventh route by Ryder and Rawling, though their itinerary seems very nearly to coincide with that of Nain Singh. For the present it will suffice to compare together four of these, namely Wellby's, Bower's, my own, and Nain Singh's.

Fig. 372. CROSSING A RIVER.

Within the limits defined, 82° to 86° E. long., we have so much of Wellby's route as intervened between his Camp No. 30 and Camp No. 55. For these twenty-six stations we get a mean altitude of 5131 m. Between the same meridians comes that portion of Bower's route which stretches from his Camp No. 10 to his Camp No. 36, and the mean of thirty-one altitudes amounts to 5125 m. Of my own journey the section from Camp XCIV to Camp CXIX falls within the same limits, and the mean of seventy measured altitudes amounts to 4780 m. On those maps of Nain Singh's route alongside the Tsangpo to which I have at this moment access only three stations are entered, and the mean of these is 4502 m. The result of these calculations is that the base or socle of the plateau slopes downwards from north to south, at first slowly though afterwards more rapidly. The first two figures call however for a word of explanation. Wellby's route follows faithfully, as mine does, the latitudinal valleys, without crossing over a single pass of the first magnitude. Bower's route, on the other hand, which runs towards the south-east, crosses of necessity over several of the mountain-ranges which stretch east or east-south-east. It is therefore not legitimate to compare without further qualification the total altitudes of the two routes one with the other; and if we desire to obtain

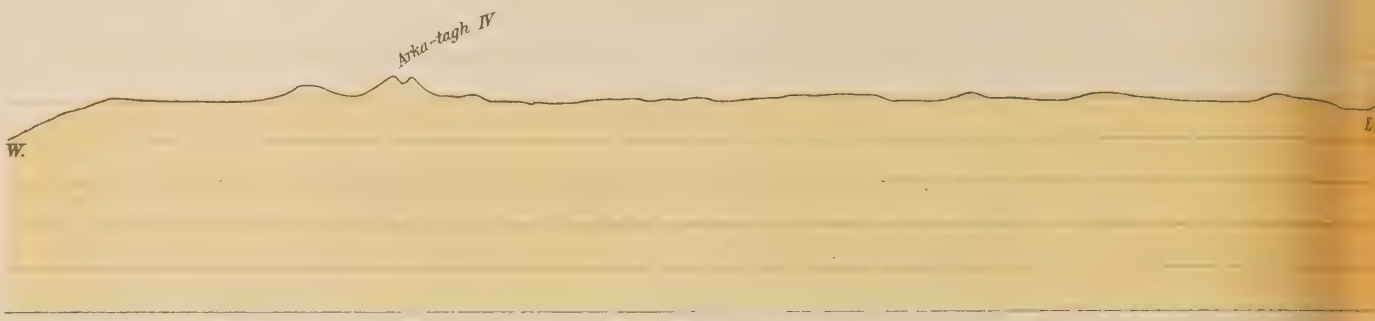
Fig. 373. CROSSING A RIVER.

the mean altitude of the base of the plateau alone, we ought to eliminate from the list of Bower's altitudes those of all passes of the first rank, that is to say such passes as, there is reason to believe, belong to mountain-ranges which farther east are connected with the ranges which I have associated together under the common name of the Tschang system. If we eliminate the passes from Bower's list, then the mean value of the twenty-one stations that remain, all of them belonging to the fundamental base of the plateau, works out at 5072 m. We then get this result: —

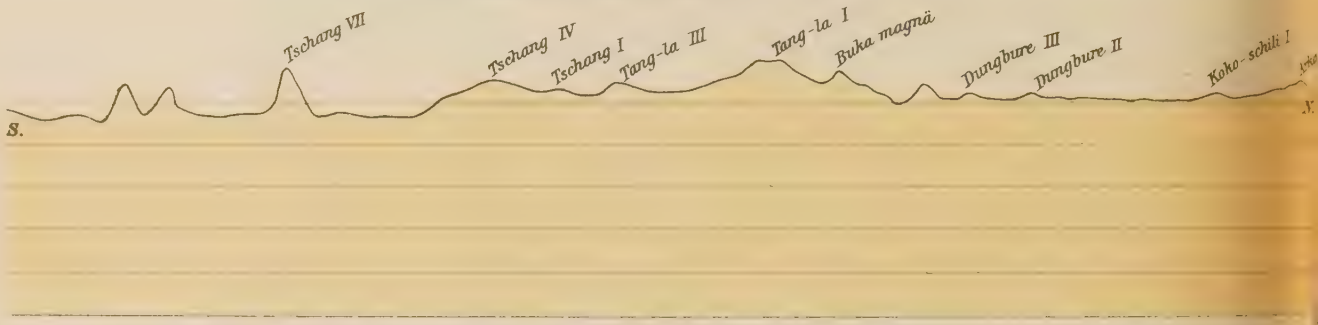
(1)	Wellby	5131 m.
(2)	Bower	5072 »
(3)	Hedin	4780 »
(4)	Nain Singh	4502 »

That is between (1) and (2) there is a fall of 59 m., between (2) and (3) a fall of 292 m., and between (3) and (4) a fall of 278 m. Wellby's is the only route lying in its entirety within the limits of the region which I consider to be the culminating swelling of the whole Tibetan highlands, and which in a more or less broad zone stretches from east to west right across the country from the Arka-tagh to the Tang-la. It is for this reason that his mean works out the highest. We may take it as quite certain, that the westward continuations of the highest mountain system in the interior of Tibet, namely the parallel ranges of the Tang-la, will be found exactly midway between Wellby's route and Bower's. The last does, it is true, cross high Tibet proper between 82° and 86°, but it does not traverse the very highest part, for that lies south of the Tang-la system and this route is 59 m. lower than Wellby's route. A decided fall towards the south is however noticeable when my route is reached, and the fall is still further accentuated when we get down to the valley of the Tsangpo.

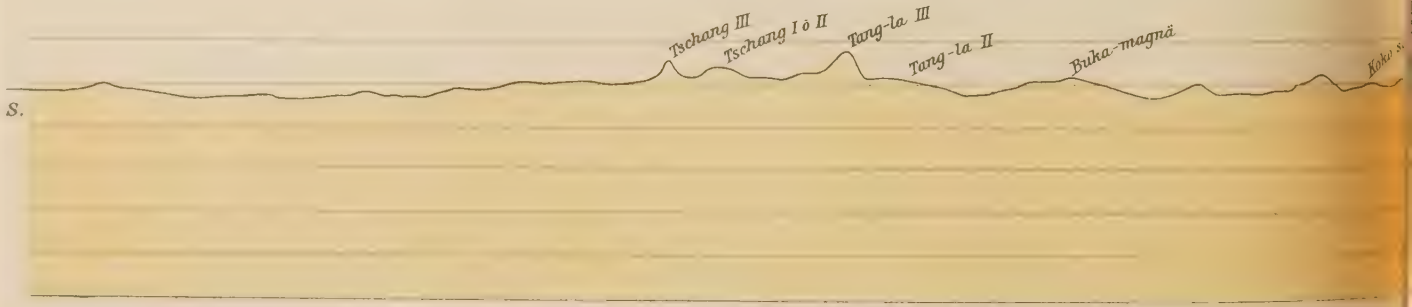
Hedin 1896.

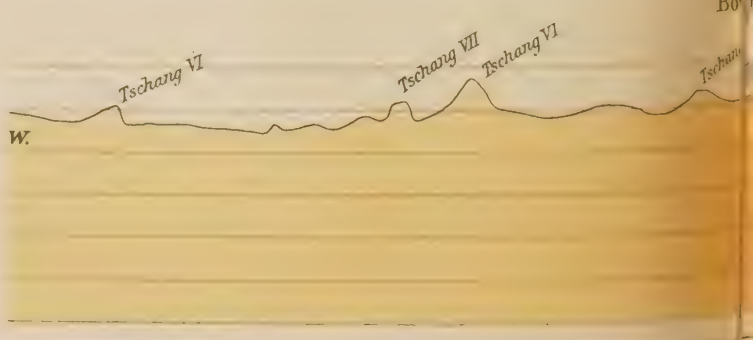


Bonvalot & Prince Henry of Orleans 1899-90.



Littledale 1895. I.





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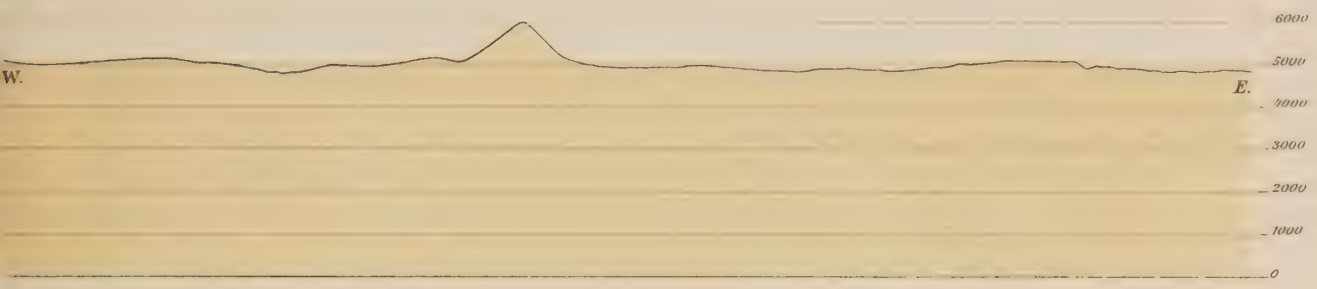

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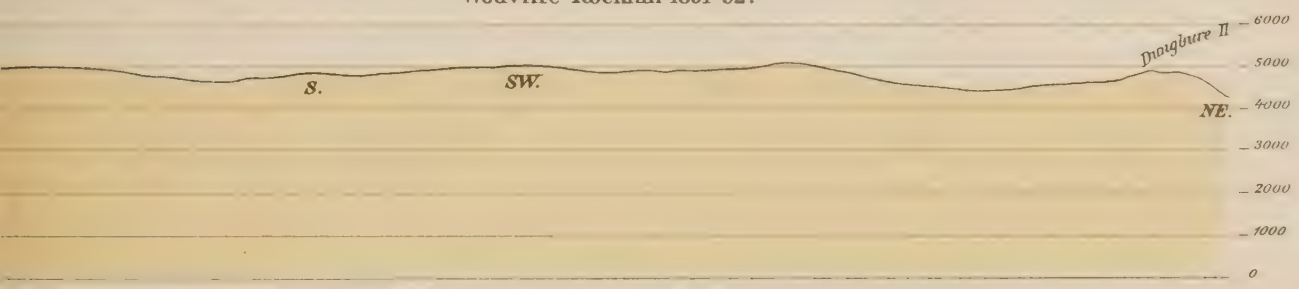

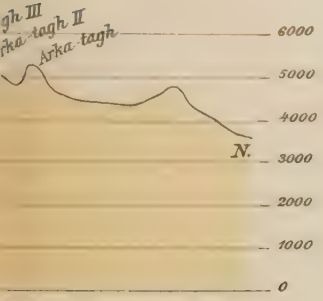

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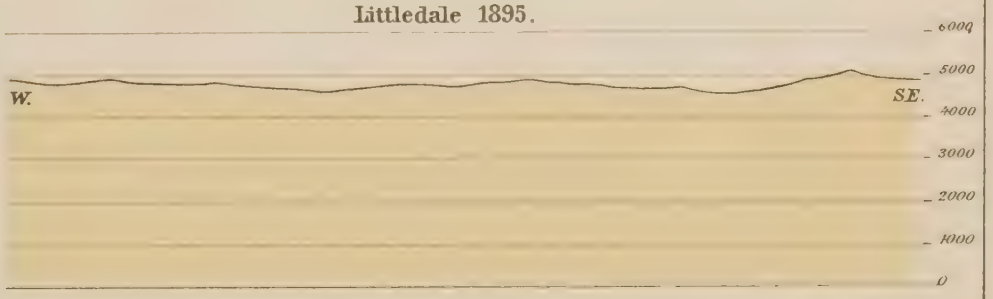

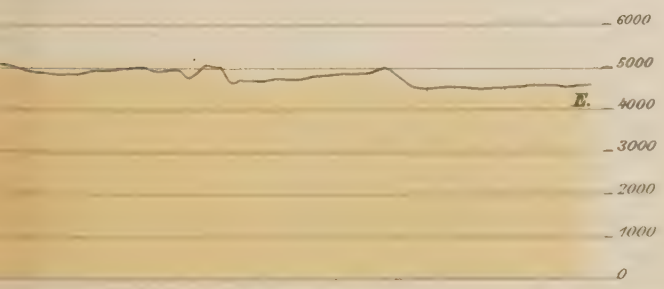

Horizontal Scale 1:3 250 000

0 50 100 200 km.

Fotolit Gen. Stab. Lit Anst. Stockh

En passant and more by way of curiosity, I will mention that Wellby, Bower, and I in the sections of our respective routes which fall within the limits defined, namely 82° to 86° E. long., travelled at precisely the same rate. While it took Wellby and me each 25 days, it took Bower 26. The reason why it took the latter one day longer was not that he made shorter stages, but simply that his line of march assumed a more diagonal direction between the defining meridians. The inference would at any rate appear to be this, that in those elevated regions there exists a limit to the marching capacity of a caravan.

A consideration of the absolute altitudes of the Tibetan lakes likewise leads to partly interesting conclusions, although the materials are yet too meagre and too irregularly distributed to yield perfectly sound results. All that can be said *a priori* is, that the same law must govern the absolute altitudes of the lakes as governs those of the fundamental base, so that the western lakes will in general lie higher than the eastern, and the northern lakes higher than the southern. In this we take into account those lakes only that lie south of the Arka-tagh, for those that lie to the north of it do not belong to the fundamental base. Consequently I exclude the

Atschik-köl	4250 m.
Upper Kum-köl	3882 »
Lower Kum-köl	3867 »
Usun-schor	2941 »
Ghas-köl	2837 »

To begin with, I will draw up lists of the more important lakes which have been touched by various explorers up on the plateau base: —

Bower:

Mangtsa-tso	5042 m.
Horpa-tso	5466 »
Tscharkol-tso	4933 »
Aru-tso	5229 »

Dutreuil de Rhins:

Jäschil-köl	5000 m.
Sumdschi-tso	5150 »

Wellby:

Treb	4939 m.
Salt Lake	5173 »
Lighten Lake	4847 »
Lake, Fresh	5213 »
Lake, Freshwater	4982 »

Deasy:

Djap-tso	5058	m.
Mangtsa-tso	5168	»
Horpa-tso	5186	»
Jäschil-köl	4890	»
Lake (drinkable)	5094	»
Saltwater lake	4899	»
Aru-tso	4942	»
Ketse-tschaka	4528	»
Njakten-tso	4387	»
Thurgu-tso	4341	»
Lima-ringmo-tschaka	4369	»

Rawling:

Arport-tso	5335	m.
Salt Lake	4880	»
Aru-tso	4878	»
Memar-tschaka	4899	»
Schemen-tso	4726	»
Bum-tso	4576	»

Hedin:

Bondschin-tso	4808	m.
Oman-tso	4505	»
Perutse-tso	4497	»
Tsolla-ring-tso	4406	»
Lake of Nov. 7	4342	»
» » Nov. 12	4559	»
Bed of Old Lake, Nov. 18	4824	»
» » » » Nov. 21	4573	»
Tso-ngombo	4317	»

Of these thirty-seven lakes eight only contain fresh water. I have excluded certain lakes which lay so far from the actual itineraries followed that it is difficult to ascertain the differences in altitude between their respective levels and the nearest measured altitude.

From the eastern part of the Tibetan plateau I quote the following lakes: —

Nain Singh:

Dangra-jum-tso	4646	m.
Ngangzi-tso	4683	»
Kjaring-tso	4503	»

Bonvalot:

Lac du Binocle	5050	m.
» des Cônes	5050	»
» Montcalm	4960	»
» de Salpêtre	4800	»
Burben-tso	4700	»

Dutreuil de Rhins:

Lac de l'Antilope	4920	m.
» des Roches Rouges	4884	»
» No. 4	4830	»
» des Hémiones	4950	»
» Jumeaux	5121	»
» désséché	4923	»
» du Sel Rouge	4698	»
Boursé-tso	4623	»
Lac des Perdrix	4450	»
» d'Ammoniaque	4635	»
Chang-cho-tso	4554	»
Tso-ring-tso	4360	»
Pam-tso	4480	»
Tengri-nor	4609	»
Boum-tso	4580	»
Boul-tso	4430	»

Littledale:

Lake of Camp 32	4805	m.
» » » 43	4872	»

Wellby:

Lake of July 25	4932	m.
» » » 28	5087	»
» » August 1	4928	»
» » » 5	4829	»
» » » 6	4904	»
» » » 9	5090	»
Lake Tschumar	4800	»

Hedin, *1896:*

Lake II	4906	m.
» V	4937	»

Lake	IX	4946 m.
»	XV	4896 »
»	XVI	4940 »
»	XVIII	4920 »
»	XIX	4810 »
»	XX	4616 »

***Hedin**, 1900:*

Lake of Camp	XXIV	5028 m.
» »	Camps XXX—XXXIII	4766 »
» »	Camp Aug. 25	4790 »
» »	» XXXV	4847 »
» »	Camps XXXVII—XLII	4848 »
» »	Camp L	4890 »
» »	» LV	4804 »
Small Lakes of Sept. 27		4907 »
Lake of Camp	LXI	4948 »

***Hedin**, 1901:*

Lake of July	2	5172 m.
» »	» 7	4923 »
» »	» 11	4952 »
» »	Camp XLVI	4972 »
Tso-nak		4716 »
Selling-tso		4611 »
Naktsong-tso		4636 »
Tschargut-tso		4617 »
Addan-tso		4617 »
Dagtse-tso		4544 »
Lakor-tso		4600 »
Small Lake		4572 »
Lake of October	24	4785 »

Of these sixty-three lakes almost all are salt. The last five are excluded from the calculations given below, because they belong neither to eastern nor to western Tibet, but to the intermediate region. Consequently we have fifty-eight lakes in eastern Tibet to be compared with thirty-seven in western Tibet. One special feature in the last-named group is that one or two of the lakes occur twice; but as our present object is to ascertain the mean altitude of the lakes, that is to say of the depressions on the plateau-base, I have deemed it expedient to let those lakes stand twice, for the reason that there exist very considerable differences between the data of the different travellers. The Mangtsa-tso, for example, lies according to Bower at an altitude of 5042 m., but according to Deasy at 5168 m. According to

Dutreuil de Rhins the Jäschil-köl lies at 5000 m., but according to Deasy at 4890 m. The altitude of the Horpa-tso is 5466 m. and 5186 m. according to Bower and Deasy respectively. As in these cases it is impossible to decide which is right, it seems best to take the two values; by so doing we shall at any rate get the mean between them.

The mean altitude for the thirty-seven western lakes is 4837 m. and for the fifty-eight eastern lakes 4811 m. Thus the difference between them is only slight, namely 26 m. If we pick out the five highest lakes in each group, *their* mean altitudes are 5227 m. and 5104 m. respectively, and the difference amounts to 123 m. By comparing Deasy's six highest lakes with my six highest, we get means of 5056 m. and 5001 m., with a difference of 55 m. The mean altitude of the twenty highest lakes in the west is 5044 m. and of the twenty highest in the east is 4983 m., and the difference 61 m. Thus no matter how you group the lakes, the mean altitude of those in the west is always a trifle higher than the mean altitude of those in the east. But this law does not hold good for the separate individual lakes, for it is perfectly self-evident that many of the eastern lakes lie higher than many of the western. Our comparison is restricted to the true plateau country; in the more peripherally situated lakes the relations are different. The Tengri-nor (4609 m.), for instance, lies 292 m. higher than the Panggong-tso (4317 m.), but Manasarovar (4660 m.) lies 450 m. higher than the Jamdok-tso (4210 m.).

These mean lake-altitudes become of especial interest when we compare them with the mean values for the pass-altitude and the plateau base: —

	Western Tibet.	Eastern Tibet.	Difference.
Pass-altitude	5477	5189	288
Base-altitude	5109	4910	199
Lake-altitude	4837	4811	26
Difference between pass and lake . .	640	378	262
» » » » base . .	368	279	89
» » base » lake . .	272	99	173

These figures show very distinctly that the surface-moulding of western Tibet is considerably more accentuated in relief than the surface-moulding of eastern Tibet. The table shows, for instance, that the difference of altitude between the plateau and the lake levels amounts in the west to 272 m., whereas in the east it is only 99 m. The difference between the pass and lake levels is in western Tibet 262 m. greater than in eastern Tibet. The western passes are 288 m. higher than the eastern; in the west the plateau-base is 199 m. higher than in the east; but the western lakes lie only 26 m. higher than the eastern lakes. These figures tell us directly, that the western lakes lie in deeper valleys and are surrounded by relatively higher mountains than the eastern lakes, and that the latter occupy broad, flat valleys and are surrounded by relatively low mountains. In other words denudation has advanced farther in the east than it has in the west. In the east we have a country which has already reached a condition of stagnation and its self-contained drainage-basins are being progressively filled up. The same thing is no doubt true

of the self-contained drainage-basins of western Tibet, but neither the denudation nor the levelling up has there advanced so far, not only because the folding of the earth's crust was there more energetic from the beginning, but also because the building up of mountain-ranges, a process which is still being continued, though with but a faint reflection of the pristine energy, is more active in the west than in the east. This is the very circumstance which causes the altitudinal difference between the western and eastern ranges to be so great, while the altitudinal difference between fundamental plateau in west and east is considerably less and the altitudinal difference between the lakes in west and east is least, being not more than 26 m. For if the process of building up the mountain-ranges is still operative in however slight a degree, it will counteract not only the levelling down of the crests but also the filling up of the valley-basins. And supposing that we may in even the feeblest acceptation of the word speak of mountain-building as being still active in the east, it is in any case infinitesimally small in comparison with the active agencies of denudation. In that quarter not only are the crests being more rapidly lowered, but the valleys are also being more rapidly filled up, than they are respectively in the west. In conformity with the assumptions made above, we might also infer, that the lakes of western Tibet ought to be deeper than those of eastern Tibet, but we do not possess the materials necessary for a solution of this problem. It would appear however as though any such law could hardly exist, for in the Panggong-tso we reached the same depth of close upon 48 m. that we obtained for the more easterly of the two freshwater lakes which we sounded in eastern Tibet. On the other hand one or two of the English explorers mention that this or the other lake in western Tibet is particularly shallow. Nor can we speak either of any noteworthy difference of altitude between the fresh and the salt lakes. In general the salt lakes lie lower, because they are always the final reservoirs in each basin, while the freshwater lakes usually have an emissary, and in the majority of cases it is precisely into a salt lake that that emissary empties itself. But on the other hand we find salt lakes at all possible altitudes, and freshwater lakes likewise at very varying elevations.

CHAPTER XL.

LACUSTRINE PROBLEMS. DESICCATION ETC.

In the foregoing chapter my sole purpose was to give a general idea of the hypsometrical relations of the Tibetan highlands. For the details along my own routes I refer the reader to the Meteorological Journal in vol. V. Once more however I would emphasise what I have already said, that my attempt is to be regarded merely as tentative, being based on very scanty materials. And the same opinion must be pronounced, I am sorry to say, upon other general accounts of the physical geography of Tibet. As promised at various places in the third and fourth volumes of this work, it was my original intention to put together a comprehensive survey of the physical geography of the country; but I have come to the conclusion that it can only be to the advantage of any such survey to postpone it for a few years longer. At any rate, that is the case as regards myself personally, and for this there exist several reasons. In the first place the assimilation and study of the great mass of cartographical material which I brought home with me from Tibet are not yet finished. The maps constructed on the scale of 1 : 200,000 are to be used as a basis for the general map of northern, eastern, and central Tibet on the scale of 1 : 1,000,000, of which I have spoken before. This map will not therefore embrace southern Tibet, that is that most interesting and mysterious country around Nain Singh's lakes and the valley of the upper Brahmaputra, as well as the country north of the Himalaya. It is for the purpose of filling up this gap that in November 1905 I purpose starting upon a new journey. I ask myself therefore, what object would be served by attempting a comprehensive account, seeing that if the same good fortune attends my new journey that has smiled upon the old, I shall within a short time be in a position to produce a comprehensive work such as I have described, but in a more complete way than is at the present moment possible. After I return from my contemplated journey I shall not only have at my disposal far more copious materials, but I shall also find my general map, so often alluded to, ready for me; besides which, I shall then be myself in possession of that general view of those parts of Tibet which I visited in 1900 and 1901 which I now lack. Without that map it would, for instance, be labour in vain to attempt to trace out the line of the water-partings throughout the whole of the internal-drainage area of

Tibet, namely the water-partings which separate that vast protuberance from East Turkestan and Tsajdam on the north, from the Pacific Ocean on the east, and from the Indian Ocean on the south. Equally difficult would it be — indeed even after the said map is finished it will be in part still impossible — to attempt to define the boundaries of the great basins of internal drainage which have been crossed over by various explorers, as also to determine their areas. Still, that would be in a high degree an interesting investigation, for it would be found that those basins, varying greatly as they do in size, are intimately connected with the general hypsometrical relations of the highlands. It would probably be found, that as a general rule the larger self-contained basins lie lower than the smaller ones.

Fig. 374. VIEWS OF THE NAKTSONG-TSO.

It would however be of even greater interest and importance to ascertain what is the morphological connection of southern Tibet with central Tibet. We have seen that the Arka-tagh may be regarded as an important orographical boundary between central Tibet and the northernmost parts of the country, and that this last-mentioned region breaks up into orographical systems which descend step-wise to lower levels. There undoubtedly exists a similar transitional region between the plateau proper and southern Tibet, with the valley of the Tsangpo. A yet further task is to establish the connections between this river and the northern transverse valleys of the Himalayas, also to ascertain the position of the water-divide between the Indus and the Tsangpo, and what relations it bears to the Himalaya and to the system which I believe to unite the Tang-la with the Kara-korum.

Another problem of great interest, and especially to climatology, is the desiccation of the Tibetan lakes. We know that the lakes all over the highlands are shrinking in area, but we do not know why they are doing so. Beside some of them there exist no distinct terraces; beside others there are low terraces arranged in

several successive stages one above another; beside yet others the beach-lines reach up to no less than 133 m. above the existing level. Some lakes are as much as 48 m. deep, others quite shallow. In some we found only little pools of water surviving amid an expanse of nothing but salt and gypsum; while others are temporary, and others again completely dried up. The varying extent to which the desiccation has proceeded does not seem to have anything to do with the absolute altitude, but appears on the contrary to be intimately connected with the positions which the several lakes ocupy on the highland plateau. The desiccation advances, for instance, more rapidly in the south than in the north, and, at an even more enhanced rate, more rapidly in the west than in the east. But what are the climatic

Fig. 375. VIEWS OF THE NAKTSONG-TSO.

or other agencies which give rise to this desiccation throughout the whole of Tibet, and that with varying degrees of energy? Probably the amount of moisture and of precipitation which is carried up from the Indian Ocean is smaller than formerly; but what is the cause of that? I leave the solution of this question to Dr. Ekholm, who has been digesting the materials of the meteorological observations. Can it be that it is dependent upon a still active elevation of the geologically recent ranges of the Himalaya, or, as Dr. Ekholm suggests, upon the encroachments which the peripheral regions are making upon the central regions? That the Himalayan water-divide is advancing from the Indian side towards the Tibetan is certain; but considering the amount of the precipitation, this change can hardly produce any other effect except that of diminishing to some extent the supplies yielded up to the Indus and the Tsangpo, without on the other hand influencing the amount of the precipitation in the interior, self-contained drainage-basins. It is more probable that the desiccation of the Tibetan lakes is dependent upon more comprehensive climatic alterations, possibly of a periodic character and affecting perhaps the whole of the

Asiatic continent; for this lacustrine desiccation is by no means confined to Tibet alone, but is attacking most of the other lakes of inner Asia, altogether apart from their absolute altitude and situation: the Sea of Aral, for instance, is drying up at a relatively rapid rate. Under these circumstances it would be difficult to unravel the special causes which conduce to the slow disappearance of the Tibetan lakes, and even if we possessed an exhaustive knowledge of the manner, and the rate, in which their desiccation is proceeding, it would not be sufficient to enable us to solve the problem entirely. But that should not deter us from endeavouring to get nearer to the kernel of the problem by exploring these lakes. What is required for this purpose is a series of surveys and detailed explorations of as many of these dried up basins as possible, and my plans for the projected journey embrace the collection of as much material of this kind as possible.

It is only when we have become acquainted with a large number of Tibetan lakes and have investigated the morphology of as many of them as may be, that we shall be warranted in drawing sound conclusions as to their origin and formation, and in the light of the results so obtained in dividing them into different groups and families, with regard to both their morphology and their geographical distribution. In the preceding pages I have given a list of ninety-two lakes, all of them relatively large and all of them with definitely ascertained absolute altitudes, although these last data vary in trustworthiness. How great is the number of other lakes which explorers have not touched, but merely seen in the distance as they marched along, and which are consequently missing in my lists, and how great, again, is the number of small lakes that every traveller passes every day between the points the altitudes of which he does ascertain! Besides, it is difficult to draw the line between lakes and pools, or quite insignificant accumulations of water. The number of the latter is legion; they occur of every shape and every size.

Inferring from those lakes which I have myself seen, I can however provisionally suggest certain varieties amongst them. To begin with, it may be said that as a general rule the Tibetan lakes are situated in the latitudinal valleys and stretch parallel to the adjacent mountain-ranges. In eastern Tibet their longer axis runs therefore from west to east, whereas in western Tibet it lies from north-west to south-east, and of this the Panggong-tso furnishes the most striking instance. The twin lakes of Kum-köl in the extreme north are a beautiful example of the parallelism between lakes and mountain-ranges. Throughout the east side of the plateau between 86° and 92° practically every lake stretches from east to west; any way exceptions are very rare, and when they do occur it is usually easy to explain the departure from the rule as due to some irregularly curved mountain-range or to a spur from such. Even in the extreme south we have another beautiful instance of this same parallelism in the lacustrine chain of the Selling-tso, Tschargut-tso, Addan-tso, Dagtse-tso, and several others; and the chain may be said to be continued in the Luma-ring-tso, the Tsolla-ring-tso etc. In both Wellby's and my own latitudinal valleys we may justly speak of real chains of lakes, or an entire series of them, all elongated from east to west and all situated in identically the same valley. As great numbers of similar lakes have been discovered south of Wellby's valley, and as they possess the same character and shape as their more northerly congeners;

as further Wellby throughout the whole of his journey across Tibet from west to east, and Bower again in the course of his journey, encountered similar lakes in the big latitudinal valleys; and as, finally, Littledale and I both discovered a quantity of elongated lakes in the valleys which we traversed on our way to the Panggong-tso, there exists every reason to believe that lakes lie scattered all over the Tibetan highlands as thick as the spots on a panther's hide. In the preceding chapters I have attempted to prove that on the fundamental plateau-base there rise long parallel mountain-ranges, with endlessly long latitudinal valleys between them. In the light of what we do know, we may therefore take it as fully established, that each of these valleys embraces a long series of lakes, exactly in the same way as my latitudinal valley and Wellby's do. Each and every one of these latitudinal valleys is divided into a great number of self-contained drainage-basins; and each such basin is bounded on north and south by the neighbouring mountain-ranges and on east and west by flat cross-thresholds in the latitudinal valley itself. The number of these self-contained drainage-basins on the plateau of Tibet is, to put it briefly, incalculable, and in point of size they vary from the tiniest pool to sheets of vast area, like the Kum-köls, Selling-tsos, and Panggong-tsos.

Fig. 376. A HILL; CENTRAL TIBET.

The regular, more or less east-west prolongation of these lakes grows generally less noticeable towards the south and towards the west. The Selling-tso is only an apparent exception, for two latitudinal valleys at least fall within the area of that lake. On the other hand the Dangra-jum-tso and one or two others of Nain Singh's lakes deviate markedly in point of shape from the general norm; though it ought at the same time to be observed that Nain Singh had only a fugitive acquaintance with these lakes, and their true shapes are pretty certainly very different from those which he has assigned to them. Great divergences are also

exhibited in the region of western Tibet that Deasy and others have explored, but then the maps of those same travellers show that the divergences extend also to the associated mountain-ranges. Seeing that these last are so pressed together, it is not surprising that the lakes — the shapes of which are determined by the shapes of the depressions in the intervening valleys — should themselves exhibit great diversity of outline. In the suothernmost of the great valleys instead of a chain of lakes, we find rivers, the Indus and the Tsangpo. The precipitation is there so abundant that the water which drops to the earth must seek an outlet for itself; but up on the high plateau the evaporation is more than sufficient to get rid of the superfluous water.

Having regard to their shape, we may discriminate between

1) flat lakes,

2) mountain lakes,

3) a type intermediate between the two,

4) annular lakes.

By a »flat» lake I understand one that occupies the bottom of a very shallow self-contained drainage-basin in a latitudinal valley. We have seen that the bottoms of the latitudinal valleys, in consequence of the advanced filling up, are as nearly as possible level, or at any rate the angle of slope on both sides from the foot of the mountains down to the lowest part of the valley is extremely slight. And when a lake forms in a valley such as that it must consequently be exceedingly shallow. An example of a lake of this kind is the big salt lake of the summer excursion of 1900, which, although covering a fairly large area, was only a couple of meters deep. It is characteristic of these flat lakes, that they possess exceedingly flat shores, which frequently form extensive plains perfectly level to look at and narrower on north and south than on east and west. In consequence of this their shore-lines are very regular and even; bays, capes, and islands are exceptional. The water is very shallow, and almost always salt; and where it is not so, the existence of some subterranean outlet is to be suspected. These flat lakes may be

1) elongated,

2) round,

or 3) of a more irregular shape. But the elongated type, with the long axis stretching east and west, is however the rule.

By mountain lakes I understand those that possess steep shores and lie for the most part squeezed in between mountains. One such lake is the Tschargut-tso. The characteristics of this type of lake are, that the shore-line is very irregular and indented, and deeply penetrating bays, projecting headlands, as well as islands, are usually found in them. By reason of their confined position between the mountains, their basins are generally deep. The water is fresh, because these lakes possess for the most part an emissary. Very often they are in fact »through» or passage lakes strung along the course of some river, as, for instance, the Tschargut-tso, the Tso-ngombo, and probably several of Nain Singh's lakes. The Panggong-tso, on the other hand, contains salt water, notwithstanding that it lies compressed between the mountains; but then it is the terminal reservoir of a self-contained drainage-basin.

Ljustr. A. B. Lagrelius & Westphal.

THE GLACIATED MASS SOUTH OF CAMP XXII, AUGUST 6, 1900 (SEE. PL. 33 THE ATLAS).

CONTINUATION TO THE RIGHT OF PL. 72 (THE TWO PHOTOS OVERLAP IN THE MIDDLE)

These mountain-lakes nearly always contain fish, and their water is wonderfully transparent. Of course they vary in outline in conformity with the varying shapes of the adjacent mountains.

Besides these there are a number of transitional lacustrine forms intermediate between the flat lakes and the mountain-lakes, belonging partly to the one type and partly to the other, *e. g.* the Selling-tso. Often too it happens that a lake which is properly a flat lake has steep mountains overhanging some part of its shores; this was the case with most of the lakes that I encountered in my latitudinal valley in 1896.

As an example of the group of annular lakes, I need only mention the Nak-tsong-tso and the Jamdok-tso. Their characteristic feature is indicated in the designation applied to them. In shape they make a more or less regular ring. Possibly there still remain several lakes of this peculiar type yet to be discovered. Their shape is prescribed by the small east-west mountain-ranges and the complete breaches effected through them whether by glacial or other agencies.

It is of course self-evident, that the lakes of Tibet admit of being classified in various other categories. Two great divisions are the fresh-water lakes and the salt-water lakes, the latter constituting the great majority. The salt-water lakes again are divisible into several classes, such as those that are slightly saline, the class usually described on the English maps by the word »drinkable», and others exhibiting every possible degree of salinity. Thus the Lower Kum-köl is moderately salt; but the large salt lake of Camps XXX to XXXIII (1900) is one concentrated salt solution. The cause of this is, that the lake simultaneously with excessive shallowness possesses a very extensive evaporation surface, together with a copious inflow of fresh water. The Kum-köl, on the other hand, is relatively deep, and although the volume of water that enters it is large, yet in proportion to the total volume of the lake the evaporation surface is nevertheless relatively small. Those lakes possess an insignificant degree of salinity which receive only a scanty supply of water, as also those which, although they formerly enjoyed an outlet, are now, like the Pang-gong-tso, cut off and deprived of their outflow. In yet other lakes the salinity appears to be subject to periodical fluctuations every year, *e. g.* the Aru-tso. In the lakes that are destitute of outflow and yet show merely a trace of salinity, a temporary effluent may be predicated, in most cases subterranean. It is the commonest thing also to find Tibetan lakes occurring in pairs, in such wise that the upper one is fresh, while the lower one is salt. We encountered combinations of this kind in the Kum-köl, in the big salt lake and the lake lying to the west of it that is fed by glacier-water, and in the two fresh-water lakes at Camps XXXVIII—XLII, which empty themselves into an adjacent salt lake; while the Tso-ngombo and the Pang-gong-tso, and probably also Dutreuil de Rhins's Lacs Jumeaux, are other examples. In the Selling-tso system we have a whole family of intimately related lakes.

In respect of their desiccation the Tibetan lakes may again be divided into several classes. In some the process is not descernible at all, whereas others have entirely disappeared; and between these two extremes there occur others at every possible degree of variation. In this connection again we may speak of temporary lakes, that is such as contain water only whilst the snows are melting, but after

that dry up, and thus are in the last stadium preceding total disappearance. And we may speak of terrace lakes, the best and most beautiful examples of which occur in western Tibet. Moreover further exploration of that part of the country

Fig. 377. SOME VIEWS OF ISOLATED GLACIATED MOUNTAINS IN CENTRAL TIBET.

will beyond doubt reveal a number of lakes which, like the Lakor-tso, have subsided more than 100 m., judging from the evidence afforded by their old strand-terraces. The shores of the Lakor-tso lie 200 to 300 m. lower than the country which immediately encircles that lake. As a rule the lakes which have disappeared

or are now in process of disappearing leave relatively deep depressions around them. A lake during the course of its gradual disappearance may pass through two or more of the variations of shape mentioned above. The Lakor-tso was

Fig. 378. SOME VIEWS OF ISOLATED GLACIATED MOUNTAINS IN CENTRAL TIBET.

formerly a true mountain-lake; at the present day it is something intermediate between that type and a flat lake, and after it has dropped still further, it will undoubtedly become a true flat lake, nowhere in contact with the surrounding mountains.

I have recently stated, that the knowledge which we now possess about Tibet leads us to infer that chains of lakes exist in all the great latitudinal valleys, and that we may legitimately picture the whole of the internal-drainage plateau

Fig. 379. SOME VIEWS OF ISOLATED GLACIATED MOUNTAINS IN CENTRAL TIBET.

country as dotted all over with lakes. All the same it would be an error to imagine them as being everywhere evenly and uniformly distributed. On the contrary, indications seem to point to their occurring in greater numbers in certain localities than in others. The regions in which they appear to be especially plentiful are between the Arka-tagh and Tang-la ranges, on both sides of the great

range which runs north of the Tengri-nor and south of my route to Ladak, and in that part of western Tibet which has been explored by Deasy and others, and which is traversed by the range that I assume to link together the Tang-la and the Kara-korum. In so far as the country between the northern foot of the Himalaya and the Tsangpo is known, it too appears to be studded pretty thickly with lacustrine sheets of water. When you enter on a provisional map all the known lakes, as well as both all the known and all the still problematical mountain-ranges of the first rank, the impression is inevitably borne in upon you that the origin of these lakes is in some way or other dependent upon these lofty mountains. In a word the lakes appear to be concentrated in greatest number in the vicinity of the highest mountains. In consequence of this one is led to surmise, that in some far distant and now vanished past the Tibetan highlands, notwithstanding that it is now vain to seek for evidences of any wide extension of ice, were nevertheless subjected to a glacial period, which, while not comparable with that which was experienced by northern Europe, was yet sufficiently powerful to scoop out these lake-basins. We know that the Himalaya, the Tien-schan, and the Hindu-kusch possessed formerly a greater abundance of glaciers than they do now, and every probability points to the same thing having been the case in Tibet. The lakes now drying up prove that the climate in that country is changing from a moister to a more arid period. On the strength of this alone we may *à priori* presuppose that the glaciated areas which once existed in Tibet are shrinking and contracting, or in other words that they were formerly bigger than they are now. At the time when the lakes swelled out to the greater dimensions indicated by certain surviving strand-terraces, the precipitation will have been so copious that the glaciers would then receive incomparably greater nutriment than they do at the present time. And going back to a still earlier period, we may conceive that the glaciation was not merely local and restricted to certain culminating portions of the lofty ranges, but regional, embracing at least the greatest of the mountain-ranges in their entirety. If these lake-basins do not owe their existence to the excavating force of the ice-streams, it is difficult to understand why they should *par préférence* be accumulated around the loftiest mountain-ranges.

With regard to the distribution of the lakes over the surface of the plateau we may also apparently lay down the general law, that they grow more numerous from north to south, and this is especially true of the eastern half of the country. But how far towards the south they continue to increase thus in number it is difficult to say; but the law does seem to hold good all the way from the southern foot of the Arka-tagh to Nain Singh's group of crowded lakes. This circumstance is probably in some way connected with the passage of the monsoons across the Tibetan highlands and the varying amounts of their precipitation which fall to the lot of the different mountain-ranges. Thus, genetically considered, the lakes must be most numerous in the south, because it was in that quarter that the glaciation was most developed, and consequently the force which chiselled out the lake-basins must there have been most active and most effective. The farther you advance towards the north the less will have been the nutriment that the ice-bound ranges caught from the monsoons, and the smaller and fewer will have been the lakes.

Nevertheless even there it is noticeable, that they are especially numerous around the loftiest mountain systems. According to this theory one would expect to find the greatest number of lakes in the extreme south, at the northern foot of the Himalaya, for it is precisely in that region that at the present day the rainfall is most abundant; but as a matter of fact, so far as our knowledge extends, the number of lakes in that part of the country would appear to be fairly small. But then we have to remember two other factors which come into play, and which we may fairly make answerable for this anomaly. The slope down from the northern foot of the Himalaya to the valley of the Tsangpo is so considerable that the surface is not *per se* adapted for the origination of lakes; and further, it may be assumed that the very presence of the river will have caused the disappearance of several of the neighbouring lakes through its filling them up itself either directly or indirectly with sediment.

In what I have just said, I purposed merely to point out certain of the problems associated with the Tibetan lakes. For my own part, I am strongly persuaded that our knowledge of them is all ~~too~~ slight to warrant us in drawing any general conclusions with regard to their formation, and it is my intention to do what I can to fill up the gaps in that defective knowledge. With that end in view it is in the highest degree desirable to explore as many as possible of the lakes of southern Tibet and through numerous soundings endeavour to ascertain their morphology, and by making exact levellings in the environs of several of them to seek to measure not only their varying degrees of desiccation, but also the different heights to which the old beach-lines reach up in the different localities. And if any at all hopeful attempt is to be made to solve the glacial problem, southern Tibet is of course the part of the country in which there exists the greatest prospect of obtaining useful results, for it is there that under all circumstances the glaciation will have been most developed, as is indeed hinted by the number of Nain Singh's groups of lakes. Yet even now I hope that Dr. Nils Ekholm will be able, from my journal of meteorological observations, to deduce some important and salient conclusions. As to the distribution of the rainfall over Tibet at the present day little or nothing is known. Up on the plateau the precipitation is relatively insignificant. In that part of the country we encountered only a few rivers, and they are not large. The Pitelik-darja, Satschu-tsangpo, Jagju-rapga, the river emptying into the large salt lake (Camp XXXIII, 1900), and the Tsanger-schar are the greatest; but it is only during the melting of the snows in summer and during the rainy season of late summer that they swell to respectable dimensions. On the other hand the peripheral regions are incomparably richer in rainfall, and it is in them that the sources of several of the greatest rivers of Asia must be sought for, more especially in the east, south, and west. In the north, on the contrary, where we are too remote from the original fountain head of precipitation, namely the sea, the peripheral regions are relatively poorly supplied with rainfall, so that the rivers which originate there are rather small, pure »babies» as compared with those on the east, south, and west. The only large stream on the north is the Jarkent-darja, and it is so partly because its upper course runs through the highlands of Tibet where they contract to their narrowest, and partly because its sources lie so far south,

that a relatively large percentage of the moisture of the Indian Ocean finds its way into them.

In Chapter XXVII to XXXIV of the present volume I have given a general view of the characteristics of the physical geography of the Tibetan plateau in so far as they can be gleaned from the pages of the various explorers and travellers, and my object in doing so was to confirm by the documentary evidence of eye-witnesses the statements which I myself make about it. All the journeys quoted from traversed the same geographical region as my own journeys do, and the leading features of that region, the northern and central portions of Tibet restricted to internal drainage, are pretty well known. All these travellers are unanimous in representing that highland region as on the whole a level fundamental plateau or socle, traversed by relatively low, flat mountain-ranges disposed latitudinally, and greatly denuded and rounded. They agree likewise in their descriptions of the intervening broad and shallow latitudinal valleys, with their numerous undrained salt-lakes. They agree likewise in their descriptions of the usually soft and treacherous ground that fills those valleys, ground which refuses to bear the weight of a caravan. This phenomenon as it exists in other parts of the world, especially in the mountainous districts of Scandinavia and in the Falkland Islands, has been thoroughly and instructively studied by my countrymen, J. G. Andersson and R. Sernander. To their theories of »travelling ground» I shall hope to return again after I have myself studied the phenomenon more closely in southern Tibet. In the pages of all the travellers quoted above we read the same descriptions of a very dead and desolate country, a highland desert, where edible grass is a great rarity, so much so that even the Tibetan nomads do not think it worth while to drive their flocks and herds thither. It is a monotonous country, where the self-same landscape scenes follow one another incessantly; the only diversities that present themselves as you travel from north to south are the successive mountain-ranges that continue to rise up in front of you between the latitudinal valleys, mountain-ranges which in their broad features all resemble one another, are all equally bare and barren, are all equally poorly equipped with hard rock. And when you travel from east to west or *vice versa*, the only diversities you encounter are the fresh lakes you successively meet with on the road; but even they resemble one another, and are equally hopeless, equally monotonous, equally lifeless. The whole of this lofty central region may therefore be regarded as belonging to one single type of regional landscape, where similar climatic conditions have given rise to similar results, where the active agencies of denudation and sedimentary deposition have produced everywhere the same uniform surface forms, a stereotyped morphology, cast everywhere in the selfsame mould.

In the south the circumstances are different. The shape of Nain Singh's lakes alone suggests that the mountain-ranges are there built up with less regularity. They also lie closer together, are in general smaller, but at the same time much steeper, and abound in hard rock. Of this country we possess but the scantiest information, having no knowledge even of what its broad features are like. Within the very last year or two the extreme south of Tibet, *i. e.* the valley of the Tsangpo, has been reconnoitred by the members of the English expedition; but the

whole of the extensive region between that valley and my route to Ladak is an absolute *terra incognita*, and it is just in this broad gap between the central plateau and the valley of the Tsangpo that the forms intermediate between the two are to be found. The investigator who should therefore attempt to set forth the general architectural features of the Tibetan swelling would be certain to lose himself in this very gap in guesses and theories devoid of all foundation. Rather than expose myself to such a risk, I have resolved to study that unknown region with my own eyes on the spot. It is only when this gap has been filled up and the white patches on our maps have given place to new groups of lakes and new mountain-ranges — which in consequence of their altitude exercise such a profound influence upon the distribution of the rainfall in central Tibet — and to new rivers — it is only then that the attempt to convey a faithful picture of the morphology of the Tibetan highlands, and to get to the bottom of the genetic causes of the existing surface forms, can be successfully carried out; for it is only then that the necessary material will be available and the necessary general view of the whole, without which it is impossible to write a physico-geographical monograph of any value. Under these circumstances therefore I prefer to postpone giving a general account of the country until after my return from the journey upon which I am now just about to start. The work which I shall then hope to be able to write may be regarded as the immediate continuation and completion of this which I herewith bring to a close. It is in this hope that I leave this last to the indulgent consideration of scientific geographers.

THE END.

GEOGRAPHICAL NAMES.

List of Abbreviations.

Bl. = Bluff.
Br. = Bridge.
Brk. = Brook.
Bsn. = Basin.
Bt. = Butte.
Chl. = Channel.
Cl. = Cliff.
Con. = Confluence.
Csai. = Caravanserai.
Ctry. = Country.
Dist. = District.
Dpr. = Depression.
Dst. = Desert.
Fd. = Ford.
Fm. = Farm.
Ft. = Fort.
Fo. tr. = Forest tract.
Fts. = Fortress.
Gd. mi. = Gold-mine.
G. hs. = Guest-house.
Gl. = Gully.
Gl. a. = Glacier-arm.
Gn. = Glen.
Gw. = Gateway.
Hd. = Highland.
Hl. = Hill.
Ht. = Hut.
Id. = Island.
La. = Lake.
Lct. = Locality.
Lg. = Lagoon.
Msh. = Marsh.
Mt. = Mountain.
Mt. ch. = Mountain chain.
Mth. = Mouth.
Mt. ra. = Mountain range.
Mtry. = Monastery.
Mts. = Mountains.
Os. = Oasis.
Pa. gr. = Pasture ground.
Pbc. = Protuberance.
Pk. = Peak.
Pl. = Place.
Plt. = Plateau.
Pn. = Plain.
Po. = Pool.
Prm. = Promontory.
Prov. = Province.
Ps. = Pass.
Rg. = Region.
Rge. = Ridge.
Rit. = Rivulet.
Riv. = River.
Riv. bd. = River-bed.
Riv. br. = River-branch.
Ru. = Ruin.
Ryn. = Ravine.
Sd. = Sand.
Sou. = Sound.
Sp. = Spring.
St. = Station.
St. hs. = Station-house.
Stm. = Stream.
Stp. = Steppe.
Tmp. = Temple.
Tn. = Town.
Tr. = Tract.
Trb. = Tribe.
Vil. = Village.
Vl. = Valley.
Vlc. = Volcano.
Wl. = Well.
Wtc. = Watercourse.

Abdal. Vil. III: 3, 254, 306, 320, 324 ff., 383, 509; IV: 510.
Abdulla-ustane-kajnasi. Sp. III: 246.
Abdur Rahman. Pa. gr. IV: 429.
Abu Bekr. Ft. IV: 430.
Addan-tso. La. IV: 33, 34, 95 ff., 100 ff., 124, 228, 500 ff., 503, 543, 545, 577, 592, 598.
Adong. Bl. IV: 198.
Adschar-tughdi. Gn. IV: 436.
Adschi-darja. Lg. The Bitter Sea. III: 116.
Aghatscha-tschat. Gn. III: 192.
Ajagh-kum-köl. La. The Lower Sand Lake. III: 61, 63, 116, 176 ff., 188, 217 ff., 229, 260, 343, 413; IV: 510.
Ajaghlik-tagh. Mts. III: 176, 189.
Ajajalik-tagh. Mts. III: 176, 178, 188, 189.
Ajghin-otak. Vl. III: 193.
Ajgin-utagnin-su. Stm. III: 177.
Ajiklik. Rg. III: 32, 272.
Ajiklik-ileghi. Stm. III: 270.
Ajiklik-köl. La. III: 271.
Ajik-köl. La. The Bear Lake. III: 32, 343.
Ak-ajtu-tagh. Mt. ra. The Range of the White Pass. III: 255.
Akas-aghsi. Ht. IV: 436, 439.
Akato. Mt. III: 353; IV: 550, 556.
Ak-atoning-saj. Vl. III: 267.
Akato-tag. Mt. ra. III: 23 ff., 40, 43, 50, 51, 62, 196 ff., 208, 226, 230, 245 ff., 255, 267, 272 ff., 277 ff., 290 ff., 302 ff., 306, 410, 418.
Akato-tagh. Mt. ra. IV: 482, 555 ff., 563 ff., 579.
Akin-lenger. IV: 444.
Ak-jar. Vil. III: 530.
Akka-tagh. Mt. III: 72, 73; IV: 508.
Akka-taghning-su. Riv. III: 176.
Ak-modur. Mt. III: 246.
Aksä. Gn. III: 365, 369 ff., 385.
Äksä. Gn. III: 363.
Aksu. IV: 417, 418.
Ak-tasch. The White Stone. IV: 409, 420.

Ak-tschoka. Gn. III: 47, 214.
Ak-tschoka-aj-tuse. Col. III: 47, 48.
Alak-nor-gol. Stm. IV: 449.
Alang-gol. IV: 559.
Alang-nor. Stm. IV: 449.
Alan-tsangpo. Riv. IV: 34, 36, 76, 82, 98, 100.
Ala-schan. IV: 453.
Aldi Tagh. Mts. The Anterior Mountains. IV: 548.
Aldy Tagh. Mts. IV: 548.
Alialikning-tagh. Mt. ra. III: 420, 421.
Ali-alik-tagh. Mt. The Mountain where Ali Hunted. III: 189.
Alim Baj-saj. Gn. III: 31, 32.
Ali Näsär. IV: 430.
Alka-tasch. Gn. IV: 439.
Altijn-gol. Riv. IV: 479.
Altin-tagh. Mt. ra. IV: 480 ff.
Altschi-samba. Pl. IV: 364.
Altyn Tagh. Mt. III: 62, 338.
Altyn tâgh. Mt. ch. IV: 499, 504.
Altyn-tagh. Mt. ra. IV: 548.
Altmisch-bulak. Sp. III: 316.
Altun Range. Mt. ra. III: 62.
Alung-gangri. Mt. III: 216, 545, 579.
Ambal-aschkan. Mt. ra. III: 51, 213.
Ambal-aschkan-davan. Ps. III: 58, 200, 213, 219, 260.
Amban Achkan. Ps. IV: 510.
Amban-aschkan. Ps. Where the Amban Crossed over. III: 213, 214, 229; IV: 558.
Amban-aschkan-davan. Ps. III: 60, 61.
Amdo. Rg. III: 521; IV: 232.
Amdo-motschu. Dist. III: 516.
Amdo ts'o-nak. Dist. IV: 465.
Amlung. Gn. IV: 187.
Amne-matschin. Mt. IV: 481.
Amrik-va. Dist. IV: 137.
Amtun-ula. Mt. ra. IV: 455.
Amur. Mt. ra. IV: 158.
Anambar. Rg. III: 19, 313 ff., 326, 359, 363, 371.
Anambaruin-eken-davan. Ps. III: 335.
Anambaruin-gol. Riv. III: 18, 306, 320 ff., 330 ff., 361, 381 ff., 385; IV: 551.
Anambaruin-kötel. Ps. III: 335.
Anambaruin-ula. Mt. III: 251, 257, 265, 325 ff., 330 ff., 346 ff., 351 ff., 360 ff., 370 ff., 382 ff., 384; IV: 138, 551, 554 ff.
Andscha-ofo. Riv. Andscha's Earthen Hill. III: 359.
Anembarula. Mt. III: 325.
Angid koul. IV: 504.
Angijr-daktschin. Ps. IV: 451, 453.
Angir-takschia. Ps. IV: 457.
Angir takshia. IV: 461.
Angirtákshia. Mt. ra. IV: 471.
Ara-jangal. Vil. IV: 440.
Aral. La. IV: 598.
Ara-tagh. Mt. The Middle Range. III: 44, 46 ff., 52, 214, 258 ff.; IV: 558 ff., 563 ff., 579.
Ara-tänesing. Gn. III: 372.
Arkarlik. Sp. III: 19.
Arkarlik-davan. Ps. III: 17.
Arkarlik-saj. Gn. III: 328 ff.
Arka-tagh. Mt. ra. The Backbone Mountains or the Farther or Remoter Mountains. III: 30, 49, 56, 63, 67 ff., 71 ff., 75, 77, 79, 81, 90, 115, 117, 156, 164 ff., 175 ff., 182, 196, 217, 224, 289.
Arka-tagh. Mt. III: 414, 416, 421, 423, 425, ff., 434 ff., 440, 448, 456, 462, 473, 475, 483, ff., 494, 512, 529, 538 ff., 544 ff., 549, 552, 553, 555 ff., 567, 568, 570, 574, 575; IV: 43, 138, 147, 343, 457, 467, 483, 494 ff., 502 ff., 508, 544, 547 ff., 557, 559 ff., 567, 570 ff., 574 ff., 579 ff., 584 ff., 588 ff., 596, 604 ff.
Arka tâgh. Mt. ch. IV: 499, 500.
Arka-taghning-su. Riv. III: 176, 178.
Arkka-tagh. Mt. III: 73.
A-rou-ts'o. La. IV: 503.
Arpa-saj. Riv. bd. III: 10.
Arport-tso. La. IV: 590.
Artisch. Dist. IV: 478.
Aru Cho. La. IV: 232, 514, 516, 522.
Aru-gangri. IV: 575.
Arupdol. Mt. IV: 242.
Aru Tso. La. IV: 520.
Aru-tso. La. IV: 232, 516, 521 ff., 589 ff., 601.
Asghan-bulak. Sp. The Spring of the Wild Brier. III: 395.
Asghanlik. Riv. bd. III: 4, 9, 255 ff.
Assam. IV: 529.
Asterabad. Tn. III: 504; IV: 534.
Astin-buktöj. Gn. III: 240, 253.
Astin-tagh. Mts. The Lower Mountains. III: 4 ff., 14, 16 ff., 21 ff., 26 ff., 29, 31, 40, 50 ff., 62, 80, 93, 138, 209, 241 ff., 245, 251 ff., 255 ff., 265, 273, 275, 278, 288 ff., 294, 296, 300 ff., 304 ff., 313 ff., 323, 326 ff., 331, 336, 338, 353, 384 ff., 389, 391, 393, 395, 397, 399 ff., 406, 411, 495, 538 ff., 544; IV: 138, 475, 483, 539, 547 ff., 554 ff., 563 ff., 579.
Astun-tagh. Mt. The Lower Mountains. III: 62.
At-atghan. Gn. The Shot Horse. III: 201, 202, 214, 230 ff., 258, 260.
At-atghan-kajir. Vl. III: 260.
Atak Habseré mengku. Pk. IV: 461.
At-atghan. Stm. IV: 482.
Atchyk koul. La. IV: 503.
Atisch. Ps. IV: 549.
Atlasch-su. Riv. III: 255.
Atschan. Rg. III: 530.
Atschik. Gn. IV: 439.
Atschik-bulak. Gn. and sp. III: 327.
Atschik-kol. Mn. ra. III: 229; IV: 482 ff.
Atschik-köl. La. III: 63, 168 ff., 180 ff., 187, 417, 420, 425, 428, 544; IV: 549, 557 ff., 589.
Atschik-kölning-kojasi. Riv. III: 176, 177.
Atschik-kuduk. Sp. III: 359, 375.
Atschik-su. Gn. III: 253, 328.
At-to-davan. Ps. IV: 552.
Avras. Os. III: 9, 49, 51, 251 ff., 254, 257.
Avras-bulak. Sp. III: 252.
Avras-davan. Ps. III: 49, 50, 71.
Avras-saj. Gn. III: 255, 256.

Baga-tsâdemin-nor. La. III: 344.
Baga-Tsajdamin-nor. La. III: 344.
Bagan-tsohan-davan. Ps. III: 576.
Bagan-tsohan-gol. Gn. III: 576.
Bagha-chalting-gol. Riv. III: 341.
Bagha Nairin. Rg. III: 341.
Bagha-särtäng-nor. La. III: 341.
Bagha-Sirtin-nor. La. III: 341.
Baghlar. Vil. IV: 440.
Baghrasch-köl. La. IV: 313.
Bagh-tokaj. Os. III: 60, 61, 202 ff., 211 ff., 230, 249 ff., 270, 389; IV: 482.
Bagma-didschi. Pl. IV: 216.
Bahan-tang. Rg. IV: 366.
Bajan-chara-ula. Mt. ra. IV: 449, 452.
Bajan-gol. Chl. III: 298; IV: 449, 453.
Bajan-kara-ula. Mt. ra. IV: 479.
Bajin-gol. Riv. III: 578; IV: 559.
Baksum-bulak. Sp. IV: 418.
Bal. Gn. IV: 277 ff., 290, 308, 521.
Balduin-dordschi. Mt. IV: 453.
Balgunto. Rg. III: 33.
Baltal. Gn. III: 351.
Baltal. St. hs. IV: 377, 379.
Balti-pulu. Gn. IV: 415.
Bamburtschi-to. Gn. III: 576.
Bandscha. Gn. III: 383.
Barangtsa. IV: 417 ff.
Barik-marlak. Bl. IV: 242.
Barik-mar-tavo. Dist. IV: 241.
Barung. Rg. IV: 142.
Barun-machaj-nor. La. The Southern Lake of Machaj. III: 343.
Barun-sasak. IV: 474.
Basch-balghun. Rvn. III: 31, 32.
Basch-balghun-bulak. Sp. III: 257.
Basch-jol. Gn. III: 16, 20 ff., 241, 251, 300, 307 ff., 316; IV: 552.
Basch-kantschi. Vil. IV: 440.
Basch-kum-köl. La. III: 63, 220, 261, 343; IV: 201.
Basch-kurghan. Ru. III: 14, 16 ff., 251, 307, 316, 323, 327; IV: 551.
Basch-lenger. Vil. IV: 443.
Basch-malghun. Rg. III: 192 ff., 203, 214, 270.
Baskak. Vil. IV: 440.
Batang. IV: 471, 498.
Batsa-singi. La. IV: 216, 217, 219 ff.
Batu-gantu-gol. Stm. III: 51, 301.
Bel. Dist. III: 33, 272.
Bel-kum. IV: 444.
Be-schui-tschuen-tsa. Gn. The White Water Spring. III: 363, 369.
Besgo. Vil. IV: 364, 366.
Besimennij. Mt. ra. The Nameless. III: 51.
Bigdo. Rg. IV: 109.
Biji. Sp. IV: 103.
Bilaulik-saj. Dist. The Grindstone Glen. III: 251.
Bilaylik-say. Dist. III: 251.
Bilejlik-saj. Gn. III: 328.
Bing-go. Gn. III: 380, 386.
Binguin-gol. Riv. III: 370.
Binocle. La. IV: 496.
Biri. Sp. IV: 120.
Bisch-arik. IV: 444.
Blue river. Riv. IV: 449, 450, 452, 479.
Bodba. IV: 405.
Bogar-dscharingo. Ctry. IV: 38.
Boghan-otak. Stm. III: 258, 272.
Boghan-ottok. Sp. III: 33.
Boghan-utschu. Tr. III: 32.
Bogtsang-tsangpo. Riv. IV: 105, 107 ff., 126, 132, 504, 545.
Bokalik. Gd. mi. III: 51, 185, 198, 201.
Bokalik. Vl. IV: 510.
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Bondsching-babtsa-tso. La. IV: 184, 185.
Bondsching-tso. La. IV: 185 ff., 189.
Bondschin-tso. La. IV: 590.
Bontsa. Mt. III: 521.
Bonvalot. Ps. IV: 576.
Bo-jigde. Stp. IV: 443.
Bora-dschungdsching. Rg. III: 342.
Boraguin-gol. La. III: 340, 342.
Bostan-toghrak. Riv. III: 10, 362; IV: 549.
Bos-tschat. Gn. IV: 430, 431.
Boulak-bachi. Vl. III: 251 ff.
Boul-ts'o. La. IV: 503.
Boul-tso. La. IV: 591.
Boum-tso. La. IV: 591.
Bourbentso. La. IV: 498.
Boursé-tso. La. IV: 591.
Brahmaputra. Riv. III: 97, 473, 512; IV: 123, 147, 184, 246, 419, 471, 473, 502, 529 ff., 533, 579, 595.
Brahmapûtra. Riv. IV: 512.
Buchain-gol. Riv. III: 578.
Buhutu. IV: 455.
Bujra-kent. Os. and riv. IV: 444.
Bujra-könäsi. IV: 444.
Buka-magnä. Mt. ra. IV: 574, 580.
Buksängö. Vil. and br. IV: 444.
Buktaning-aghsi. Gn. III: 14.
Buktöj. III: 240, 253.
Buktöj-saj. Gn. III: 238, 239.
Buktu. Gn. III: 14.
Bulak. Sp. III: 27.
Bulak-baschi. Sp. and Vl. III: 54, 61 ff., 66, 72, 251 ff., 259, 536.
Bul Cho. La. IV: 514.
Bulundsir-gol. Riv. III: 19.
Bulungir-gol. Chl. III: 298.
Bulungir-nor. La. III: 340 ff., 343, 346.
Bum Cho. La. IV: 228, 233.
Bumsa. Mt. IV: 452.
Bum Tso. La. IV: 520.
Bum-tso. La. IV: 590.
Burchan-Budha. Mt. ra. IV: 448 ff., 451, 481.
Burben-tso. La. IV: 498, 591.
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Caspian Sea. La. III: 116, 504.
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Chabuk. IV: 511.

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Chaga Namgha. Sp. III: 341.
Chaidam. Ctry. IV: 471.
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Chal-saj. Mt. III: 60, 61.
Chaltaning-saji. Gn. III: 14, 15.
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Chal-tüschkün. Gn. IV: 426.
Champa. Dist. IV: 218.
Chan-ambal. Vl. III: 19.
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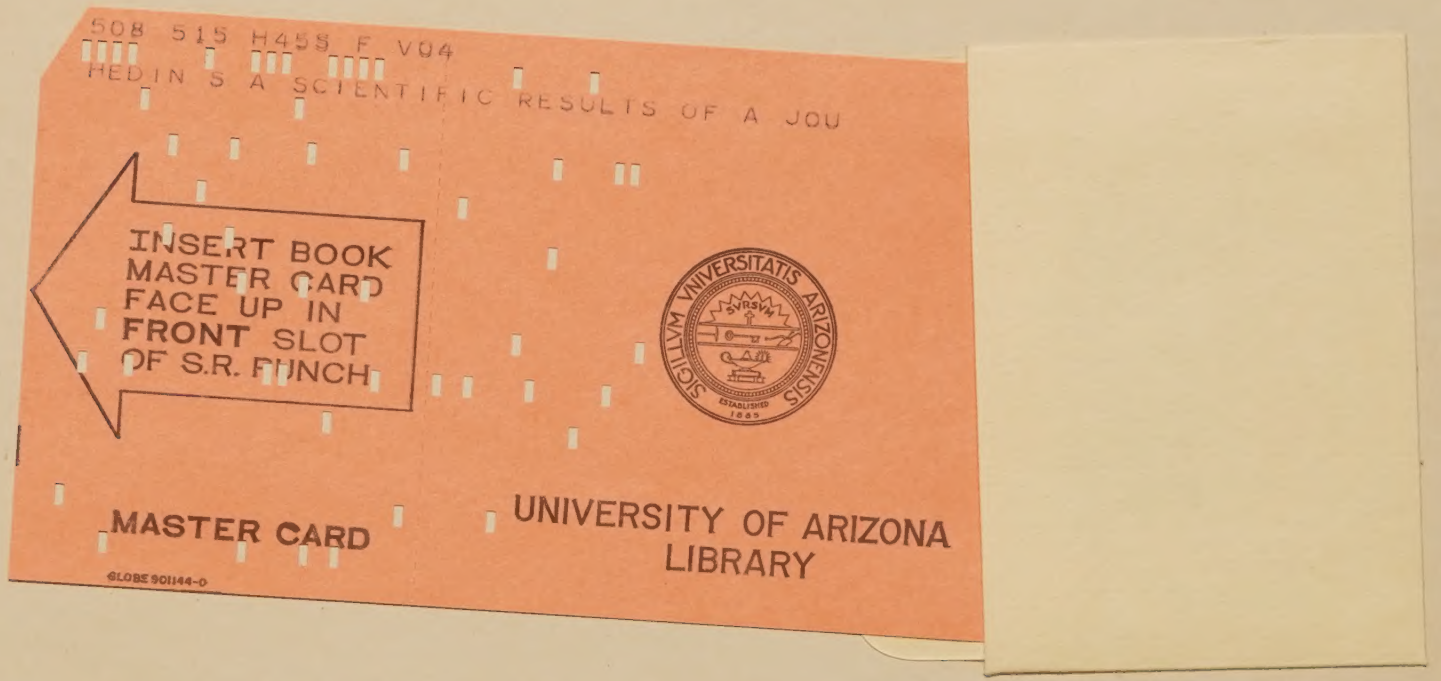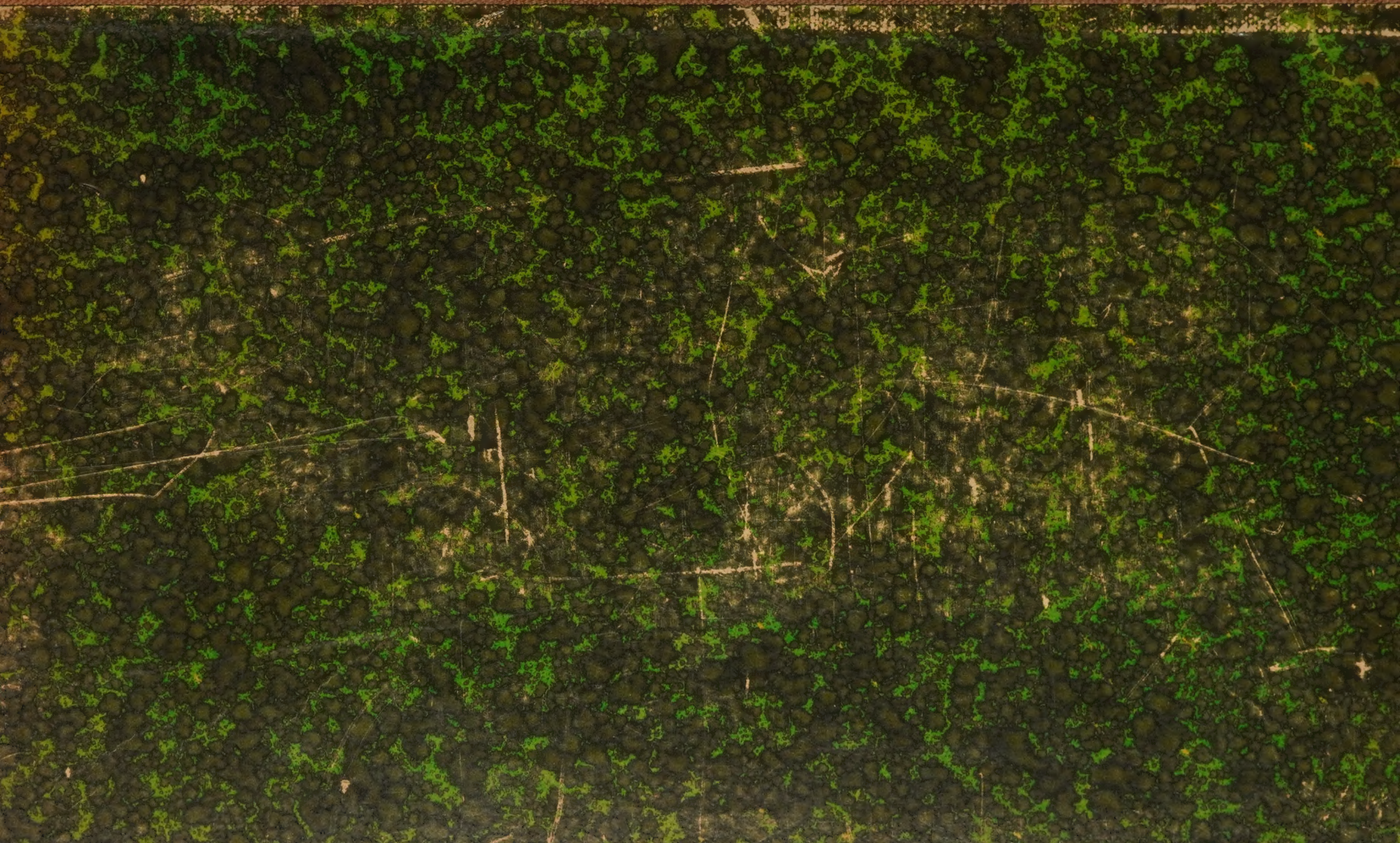
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